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THE AMERICAN ROLLER-SKATE RINK IN PARIS.

It will be remembered that in the SCIENTIFIC AMERICAN, about a year ago, we traced the history of the roller-skate, the invention of Mr. Plympton of this city, and which has met with a certainly phenomenal success. After introducing the skate in this country, and thus converting empty halls all over the land into temporary skating rinks, Mr. Plympton, after having effected the introduction of his skate in this country, and after having disposed of a number of rights for its use, took his invention to England. In that country the winters are rarely cold enough to produce ice of sufficient thickness on ponds and rivers to secure good skating more than for a few days in the year; and very frequently it happens that entire winters pass without affording skaters any opportunity whatever for their favorite amusement. Consequently the roller-skate met with an appreciation in England far beyond that which it encountered here, and before long immense rinks were erected, on the smooth waxed surfaces of which John Bull, whether duke or costermonger, disported with huge gratification to himself and to the material profit of the enterprising inventor.

While ice suitable for skating is rare in England, it scarcely ever forms in France, and the furore in the former country spreading across the channel, the English company controlling the invention undertook its introduction into Paris. Purchasing from the city a suitable site in the Chaussée d'Antin quarter—a prominent locality—the company have recently erected a magnificent structure, the interior of which is represented in our engraving from *L'Illustration*. The floor is about 300 feet long by 50 feet wide. The enterprise has proven highly successful, and the Parisians are now undergoing a skating mania which bids fair to last for some time.

ICE SKATING IN SUMMER.

In London two skating rinks, having artificial ice floors, are now in successful operation.

The floor of each rink is arranged in the form of a shallow basin, on which are laid a series of flat or oval pipes. The basin is filled with water so as to cover the pipes. The pipes contain glycerine and water, which is made to circulate through the pipes by steam power; the liquid within the pipes is refrigerated by the evaporation of sulphurous acid gas, contained within a tank, through which one end or portion of the rink basin pipes pass. The sulphurous acid gas is condensed into liquid form by compression pumps as fast as it evaporates in the refrigerating tank, and then allowed to evaporate again. Thus a continual evaporation goes on within the tank, producing a temperature of from 30° to 40° F. below the freezing point. The circulating glycerine and water is thus so greatly reduced in temperature that the water in the rink basin congeals, and remains solid so long as the apparatus is kept in motion.

PROJECTED ARCTIC EXPLORATIONS.

Dr. Petermann has sent us a long letter on the English Arctic Expedition, which he has addressed to the President of the Geographical Society. Dr. Petermann says he has made himself acquainted with the history of every Arctic and Antarctic expedition that has ever been undertaken, and it appears to him "there never was a more able and heroic expedition than that of Capt. Nares'. Capt. Nares' expedition may be said to have '*finished*,' as it were, a great portion, say one-third, of the Arctic regions. . . . From Smith Sound to Behring Strait, the region of the Palæocrystic Sea, our knowledge is entirely due to British enterprise and perseverance." Petermann thinks Sir George Nares has exploded the fallacy of the continuous navigability of the Smith Sound route, and that it required the greatest moral courage to return with results diametrically opposed to what was expected. He thinks that had he been able to stay another winter and gone round to East Greenland, he would also have "finished" the Pole. Petermann thinks it has been a triumph of seamanship that the commander has been able to bring back the two ships safe and sound, and that if our "enlightened and liberal Government remains true to the English way of doing things, in a complete way, and not by half-measures, it is to be hoped that these vessels will once more be sent out by a more promising route." He then refers to the six routes to the Pole, advocating the Novaya Zemlya and the East Greenland routes. He believes there is a great open sea all along Northern Siberia, and states that Prof. Nordenskjöld intends in 1878 to sail right across from Norway to Behring Strait. Petermann believes that a high latitude could easily be obtained along the west coast of Franz-Josef Land, and maintains that no proper attempt has been made since Parry's journey in 1827 to push north beyond Spitzbergen. But of all the routes that by East Greenland is the one which he advocates most strongly. He maintains that throughout the summer the East Greenland coast is almost free of ice, and even in winter there is a strong outward drift. He firmly believes that an expedition, like that which has just returned, would have no difficulty in sailing direct north, crossing the Pole, and coming out at Behring Strait. These views are based on the observations of the whaling captain, David Gray, and on the known drift of the Polar currents. The well-established current by the Smith Sound route brings down much ice, but much more of the Palæocrystic ice must escape by the wide opening between East Greenland and Spitzbergen. The ice drift must leave an open space behind, and there is therefore good reason to believe that in the Polar region will be found an open sea. Petermann is convinced that Sir G. Nares, with the Alert and Discovery, could steam right to the Pole by this route, probably in one season. He thinks it possible, moreover, that East Greenland and Franz-Josef Land may approach each other towards the Pole, and still maintains the prolongation of Greenland across to Behring Strait, in however, it appears to us, a somewhat modified and less objectionable form. He considers the central region to be divided into two nearly equal areas of land or islands, the one extending from the shore of East Greenland in about 20° W. long. over Baffin's Bay, Parry Island, and Point Burrow, Behring Strait, and Cape Yakan, in about 176° E. long.; the other half thence all along the Siberian coast, over Franz-Josef Land, Spitzbergen, to East Greenland. These two regions are in all respects distinct. In the two former, or western, the land prevails, in the latter, sea. "It is not at all unlikely," Petermann states, "that Eskimos will yet be found right under the North Pole." A Swedish and a Dutch expedition have, he assures us, been decided on. He has no hope of anything being done, meantime, to carry out Weyprecht's scheme. The mass of data collected by various expeditions has not yet been half worked out. He still maintains, "It might be done, and England ought to do it." We have endeavored to give the drift of Dr. Petermann's letter without comment.—*Nature.*

THE AMERICAN ROLLER-SKATE RINK IN PARIS.

ON THE MINUTE MEASUREMENTS OF MODERN SCIENCE.

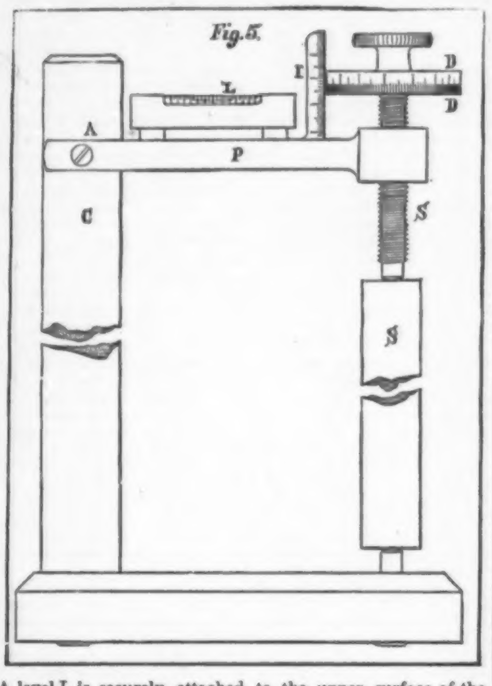
By ALFRED M. MAYER.

Article III.

2. *On the method of measuring by means of the micrometer screw furnished with the contact level.*

The Contact Level is the name given to a spirit level, which is so applied to a micrometer screw, that when the bubble is in the middle of the level we have the screw in the position which is taken for its contact with the body to be measured. The manner in which this application of the level is made may be clearly explained by aid of the accompanying drawing, Fig. 5.

In a plate of brass, P, is cut a slot at its end, A, so that a stout, square rod C can fit loosely into this slot. Two screws —one of them shown at A—enter the sides of the plate P, and traversing it, their points enter conical holes in the rod C. By this mechanism the plate P is hinged on the points of the screws, at A, to the stout rod C, so that when the screw D is rotated the plate P revolves around A as an axis.



A level L is securely attached to the upper surface of the plate P, and to the same plate P is fastened the index I, carrying a scale of equal parts; each of whose divisions equals the pitch of the screw. At the same time the portion of the pitch of the screw is shown by the division on the screw drum D, which is cut by the edge of the index I.

To illustrate the manner of using this apparatus, we will suppose that we wish to compare a carefully constructed yard or foot measure with another standard yard or foot measure, which has been furnished us by the Government Bureau of Weights and Measures. The standard measure, or its carefully made copy, is placed in Vs (not shown in the figure), so that it takes a vertical position. The screw, S, is now slowly turned till the bubble comes into the middle of the level L. The number of the revolution and the fraction of the revolution of the screw are taken from the index I and from the drum D. The standard measure is now removed from the apparatas and the yard or foot, whose error we wish to ascertain, is placed in the same position as that formerly occupied by the standard. If the bubble now occupies the center of the level, then the two measures are of the same length; or, more correctly speaking, they are so nearly of the same length that they do not differ by the smallest length that can be shown by the motion of the bubble of the level. If, however, as is generally the case, the bubble does not come to the center of the level, when the standard is replaced by the measure, then it is brought there by rotating the drum D. If to bring the bubble to the center of the level, we had to move the screw downwards, then the scale is shorter than the standard. If we had to move the screw upwards, then the scale is longer than the standard. The error of the measure is obtained by subtracting the reading given by the screw when the measure was in the apparatus from the reading given when the standard measure was in the apparatus (the bubble of course being in the center of the level in both cases), and by multiplying the remainder by the pitch by the screw.

The reader, of course, understands that in all of these comparisons the temperature of the apparatus, of the standard and of the scale, is the same, and also that during these measures the temperature remains constant.

The degree of precision of a micrometer screw furnished with a contact level depends on the delicacy of the level. With an instrument similar to the one here described, with a level about as sensitive as can well be used for such purposes, and with a micrometer screw of a pitch of $\frac{1}{50}$th of an inch, I obtained the following series of readings on the drum of the screw for nine successive level contacts of the screw on the end of a stout brass rod:

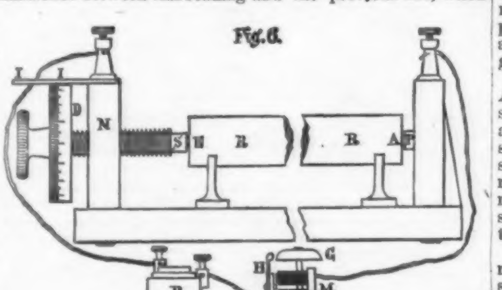
No.	Measurement.	Dif. betw. mean and measures in fractions of rotation of screw.	Dif. betw. mean and measures in fractions of an inch.
1.	6.50	+ .234	.0000234
2.	6.25	− .016	.0000016
3.	6.00	− .266	.0000266
4.	6.10	− .166	.0000166
5.	6.40	+ .134	.0000134
6.	6.30	+ .034	.0000034
7.	6.50	+ .234	.0000234
8.	6.40	+ .134	.0000134
9.	6.00	− .266	.0000266

Mean = 6.266

The drum of the screw is divided into 100 equal parts; hence each of these parts equals the $\frac{1}{5000}$th of an inch. The greatest range in the readings of the drum, as shown in column 2, equals .5 or $\frac{1}{2}$ of a division. This range is therefore equal to $\frac{1}{10000}$th of an inch. In the third column I have placed the differences between the mean of all the measures and the mean of each successive measure expressed in fractions of an inch. The greatest departure of any one of these differences from the mean of all of the measures is $\frac{266}{10000000}$ths of an inch, or, what is the same, the $\frac{1}{37594}$th of an inch. As this is the extent of the greatest departure of a measure from the mean of them all, and as the greatest range among the separate measures is $\frac{1}{20000}$th of an inch, we feel sure that the mean of nine measures will give us the true measure to at least the $\frac{1}{10000}$th of an inch.

3. *On the method of electric-contact applied to measurements with the micrometer screw.*

With the aid of the accompanying drawing, Fig. 6, I will describe the method of obtaining the contacts of a micrometer screw by the aid of a current of electricity. In this method we take as the position of contact that distance of the end of the screw from the surface of the body to be measured, that will just allow a current of electricity to pass between these surfaces. It matters not if this passage of electric current really takes place before the screw touches the body we are measuring; all that is essential is that the distance at which this passage of electricity takes place shall be exactly the same in all of our measures on the body. If the latter condition can be obtained, then the differences between two successive measures will give us the distance we wish to measure. Thus, suppose it be required to measure the increase in length of a metallic rod, when its temperature is increased by a known number of degrees of the thermometer. By appropriate means, which we have recently devised, and which will be described in a future article, the rod can be entirely surrounded by ice or by a current of steam, and yet its ends can be exposed so that the abutting point P, and the end S of the micrometer screw, can be brought in contact with the ends of the r[illegible] end A of the rod is brought into contact with the abutting point P by means of springs, which are not shown in the drawing, but which pull the rod R against the abutting point P, with a pressure which is the same in successive measures. Also, the weight of the rod is partly supported by two springs which reach down from supports above and take hold of the rod at distances from its ends equal to one-fourth of its length. We will suppose that the rod has been cooled down to the temperature of 32° Fahr., by having been immersed for several hours in melting ice. The rod surrounded with ice is now placed in the apparatus, and the springs are attached to the rod to bring it against the abutting point P. The screw S is now slowly rotated and its end gradually approaches the surface E of the rod. At a certain moment the screw S touches the end surface E of the rod, or, at least, it comes so near, that an electric current passes between the screw and the rod. This electric current is generated in the battery B, and thence passes to the block N; then through the screw S and the rod R to the electro-magnet M. This magnet then attracts the iron lever H, and thus brings the hammer at its end to strike the bell G, and to apprise the experimenter that the micrometer screw is in contact with the end of the rod. The reading is now taken from the scale of the index I, and from the drum D of the screw. Steam is now passed around the rod, and after it has ceased to lengthen from the increase of its temperature, we are sure that the rod has the same temperature as that of steam; in other words, is heated to 212° Fah. or 100° C. The screw is again slowly approached to the rod till the moment when the electric current passes and sounds the bell. The rotation of the screw, at this signal, is stopped, the readings of the index and drum are again taken, and the difference between this reading and the previous one, when



the rod was at the temperature of melting ice or 32° Fah., gives the increase in length of the rod when it is heated through 180° Fah. or 100° C. From this measure is readily determined what fraction of the length of a rod, of the material of the one experimented on, expands by having its temperature increased one degree of the thermometer.

The precision of this method of measurement depends upon the following conditions: First, the battery should furnish a constant strength of current and also a weak current; secondly, the electro-magnet should be formed of a short and thick wire; thirdly, the rotation of the drum of the screw should be made so slowly that only a very slight error is produced by the delay in stopping the rotation of the screw at the moment the electric current passes between it and the rod. Indeed, the chief error in the method consists in the difficulty of ceasing to revolve the screw at the very moment that the bell sounds. It takes some time for the signal thus received by the ear to be interpreted by the brain, and thence, for this order to be sent to the hand from head-quarters, *stop turning that screw!*

This order, no doubt, is always sent from the brain with the same velocity — with a speed, according to Helmholtz, of about 95 feet a second—but the hand is not able to turn the screw always with the same velocity of rotation, hence the screw is rotated, in successive measures, through a greater or less fraction of a turn, after the order to stop moving it has been received.

The writer has, to-day, made a series of measures with an apparatus similar to the one just described, and he has found that with a screw of the pitch of $\frac{1}{50}$th of an inch, provided with a drum divided into 200 equal parts, that the greatest difference between the measures amounted to only the $\frac{1}{10}$th of a division on the drum, or, in other words, to the $\frac{1}{100000}$th of an inch.

MONSTER BAROMETER.

A LARGE aneroid barometer has been placed in the most prominent part of the Paris Halles for the use of the country people who come daily to sell their garden produce. The dial is about 5 feet in diameter, and is lighted at night.

THE SENSATION OF SOUND.

AT a recent meeting of the Vienna Academy a paper was communicated by Dr. Isidor Hein "On the Relations between Perceptions of Touch and of Hearing." His conclusions are these:—1. The sound produced by striking a solid body is always accompanied by a sensation of touch, which, like the sound, differs according to the nature of the body. If the sound is different in different parts of a body, there goes along with the variation of the sound, a variation in the touch-sensation; and if the surface be divided into several sections according to differences in sound, a congruent division may be made on the basis of touch. 2. On bringing a struck body towards a reflecting wall, the sound and touch-perceptions show similar variations. 3. To the touch-perception in question correspond vibratory motions of the exterior body, produced even with the weakest striking, whereas sound only begins to be perceived with impacts of a certain intensity. 4. The sense of touch is capable of perceiving vibrations and comparing the differences of these. It brings hereby to consciousness, a special quality of touch-sensation, which is to be distinguished from sensation of pressure. 5. This distinguishing power of the organ of touch, not sufficiently appreciated hitherto, offers practical medicine a peculiar mode of investigation, which greatly enlarges the doctrine of the physical symptoms of the human organism, and for which the author suggests the (German) name of "Erschutterungs-palpation."—*Nature.*

MAGNETIC ACTION OF ROTATORY CONDUCTORS.

By F. ODSTREIL.

FROM a large number of observations of the magnetic effects, caused by a rotating sphere of zinc upon magnets in the vicinity, the author finds that considerable deviations are caused as long as the axis of the sphere does not lie in the direction of the terrestrial magnetism. The law regulating the distribution of magnetic force according to the inclination of the axis has been fully defined. As these induced currents in a rotatory sphere are due to terrestrial magnetism, the opinion of the author is strengthened that the periodically recurring deviations of the needle are possibly due to solar and lunar magnetism.

THE METRIC SYSTEM.

AT a recent meeting of the Boston Society of Civil Engineers, the committee on the Metric System made a report, from which we glean the following:

Probably the most important step lately taken is in Sweden, where the Diet has voted to adopt the metric system; its obligatory use to date from 1889. In the United States the Treasury Department has distributed metric standards to the several States, and has introduced the new subsidiary silver coinage of metric weights; the twenty cent piece weighs five grams, as does also the five cent nickel; the weights of the other silver coins are, of course, proportional to their values.

The General Postal Union, ratified by treaty at Berne, October 9, 1874, includes twenty-one nations, and has expressed its rates entirely in the metric system. To this union the United States is a party.

The celebrated American Watch Company, at Waltham, Mass., uses the metric system entirely in its works. The change from English measures was made a few years ago with comparatively little difficulty, by letting the old tools become nearly worn out in the service, and then putting the new ones in their places. The American Watch Tool Company, also of Waltham, has adopted the metric system, and another factory in New Jersey is reported in the same category.

An organization has been formed in Boston city, called the American Metric Bureau. According to Article 2 of its constitution, "it will secure the delivery of addresses; publish articles, circulate books, pamphlets, and charts; distribute scales and measures; introduce the practical teaching of the system in schools; and in all proper ways, as far as the means at its disposal will allow, the Bureau will urge the matter upon the attention of the American people, till they shall join the rest of the world in the exclusive use of the international Decimal Weights and Measures."

The Franklin Institute of the State of Pennsylvania has resolved, "that while we decline to ask for or favor compulsory legislation to enforce a change in our weights and measures at this time, we believe that the adoption of a harmonious system of money, weights and measures, throughout the bounds of mercantile intercourse, is most desirable;" and it has adopted a committee report, signed by Messrs. Coleman Sellers and W. P. Tatham, setting forth "that the objections to the attempt to adopt the *meter* as a standard unit of lineal measure are overwhelming." The full text of this report may be found in the "Journal of the Franklin Institute" for June, 1876, where is also printed a report by Robert Briggs, the minority of the committee. He protests against the perversions of history and erroneous assumptions as to the consequences of introducing the metric system contained in the majority report, and says, "The universal introduction of the metric system is merely a question of time."

The Report concludes as follows:

After advising so many other people to use the metric weights and measures, we think it would be a graceful thing for the members of this society to do something themselves towards actually adopting them. We think that the place to begin is in writing scales on plans. We recommend, therefore, that upon every plan that has its scale shown by a graduated line indicating feet, miles, etc., a second line should be drawn as a scale of meters. This requires very little additional labor, does not injure the plan for present use, and may enhance its future value, shows what is now the lawful standard of the United States, and how long the meter is as compared with the foot, and it gives the draughtsman his first lesson as to the difficulties that lie in the way of the metric system. This practice can perfectly well be adopted by a very few persons, or even by a single individual, unsupported by the rest of the community.

MICRO-PHOTOGRAPHY.

THE process of micro-photography, adapted so successfully by Colonel Woodward, head of the Army Medical Department of the United States, at Washington, consists in using the heliostat, from whence is thrown a fine pencil of sunlight through the microscope into the camera in a darkened room. Colonel Woodward prepares the finest enlarged micro-photographs ever produced. He has, among other things, by this means clearly demonstrated that any difference between the blood of man, dog, guinea-pig, is microscopically indistinguishable, a fact which has been heretofore contested.

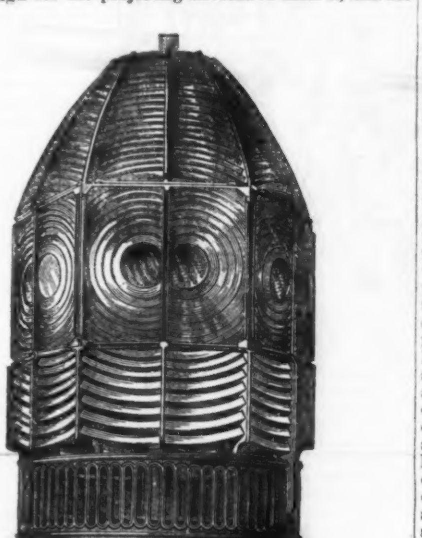
THE LITTLE BASSES LIGHTHOUSE.

ONE of the most interesting objects at the Loan Collection at South Kensington, London, is the optical apparatus and lantern of the Little Basses Lighthouse, which is now in course of construction by Mr. William Douglass, C.E., from the designs of his brother, Mr. James N. Douglass, the engineer to the Corporation of the Trinity House, upon the Little Basses rock, which is part of a reef situated about seven miles to the S.S.E of the island of Ceylon.

This apparatus has proved a great source of attraction to the general public from the fact that its light has been exhibited with its rotating apparatus in motion every evening when the Exhibition has been open to the public.

The Little Basses is only awash at low water, and is seven miles from the shore. These reefs, which are composed of hard red sandstone, are exposed to the full fury of the sea during the northeast and southwest monsoons, so that the days available for working are few, and these are almost exclusively during the prevalence of the northeast monsoon, which commences in November and terminates in April, and even of this short period only half of it can be relied upon as safe for working. The whole of this coast is exposed to heavy surf from the south and southwest, and as there is no shelter for shipping nearer than Galle, that place, though one hundred miles distant, was selected as the depôt from which the operations at the rock were to be carried on.

The tower of the Little Basses Light, which is now completed, is of Dalbeattie granite, and has, like that for the Great Basses, been prepared and fitted together in the quarries of Messrs. Shearer Smith & Co., of Dalbeattie, and before leaving this country each block was marked for its particular place, so that very little skill was necessary in putting them together in Ceylon. The blocks forming the walls and floors of both lighthouses are dovetailed together, both vertically and horizontally, upon the system adopted by Mr. Douglass in the Wolf Rock and Hanois lighthouses. Across the upper surface and also on one end of each stone is a raised dovetailed band, and on the underside as well as the opposite end is a corresponding dovetailed recess. This recess is just large enough for the projecting dovetail to enter it, and the



space between them when fitted together is filled with Portland cement. The whole structure, walls, floors, and foundations becomes, therefore, one solid mass of granite, which will in all probability be everlasting, requiring no annual outlay for painting or repairs. The tower has a diameter of 33 ft. 3 in. at its base, and of 16 ft. 6 in. at the top under the lower gallery, and contains about 1,720 tons of granite. The concave outline of the shaft is elliptic, having the curvature of an ellipse whose major axis is 148 ft., and whose minor axis is 28 ft.

Two iron twin-screw steamers, each capable of carrying 120 tons of granite and fitted with two pairs of steam winches, were used for conveying the materials from Galle to the rock, and, although they could not get nearer to the latter than 180 ft., blocks averaging 2¼ tons in weight were hoisted out of the hold, landed, and deposited 28 ft. above the rock at a rate of ten per hour, and this entirely by the steam power on board the vessel from which the stones were being lifted.

The method of landing the stones, which was adopted for the first time by Mr. Douglass in the erection of the Great Basses Lighthouse, proved so satisfactory that he has employed it in the construction of the tower at the Little Basses. A strong mast 45 ft. high, and supported by chain guys, was shipped into the rock in a vertical position, and from this was supported a derrick which could be swung over towards the tower by means of a chain and crab. The steamer was moored at a distance of 180 ft. from and parallel to the rock, and the blocks of granite contained in the hold were ranged on two tiers of rollers, so as to facilitate their being brought under the hatchway, where an iron lift working in guides conveyed them to the level of the deck. One barrel of the forward winch lifted the stone to the deck and deposited it on rollers in readiness to go out of the gangway. To one barrel of the after winch was attached the end of a half inch chain, which passed first through a leading block at the gangway, then through another at the foot of the derrick, through a pulley at its top, and from thence through a block attached to the stone, and back to the head of the derrick where it was made fast. For easing off the stone and to keep it in check there was attached to it a second chain, the further end of which was coiled on the second barrel of the forward winch, which was controlled by a powerful brake. In landing a stone the aft steam winch was started, and, as the stone went over the side, the controlling chain was eased away by the brake until the stone entered the water, when it was gradually "paid" away as the after winch worked the stone ashore. The stone on reaching the shore was swung by the derrick towards the tower and lowered into its place. When the building rose to a height too great for the derrick to work, a steam winch was fixed upon the rock for hoisting the granite blocks to the top of the tower. By the very ingenious contrivance by which the stones were conveyed from the ship to the rock below the surface of the water they were out of the influence of the wind, and at the same time more than two fifths of their weight was taken off due to

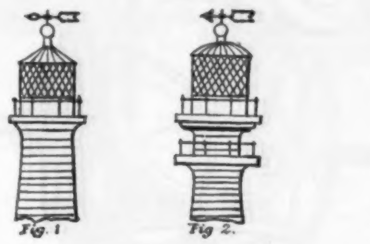


Fig. 1 Fig. 2.

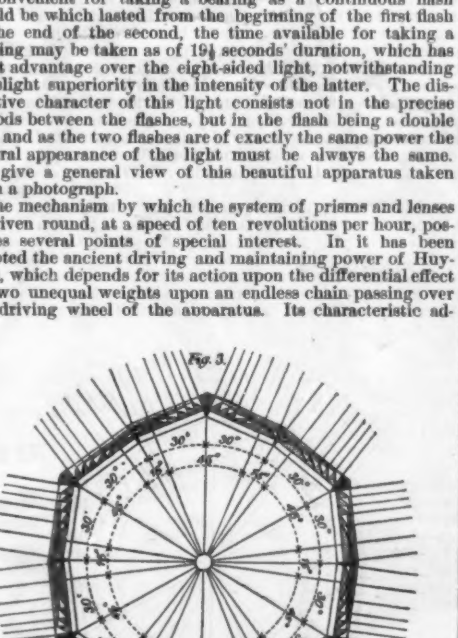
their immersion, and to the difference between the specific gravities of granite and sea-water respectively.

The illuminating apparatus of the Little Basses Lighthouse is of a novel character, being upon the very beautiful "group flashing" system of Dr. Hopkinson, whereby flashes in groups of two or more are given in quick succession instead of single flashes at stated intervals of time. The first order dioptric apparatus for the Little Basses has been designed by Dr. Hopkinson, and manufactured by Messrs. Chance Brothers & Co., of Birmingham, whose firm stands first in the world for this class of work. It is a twelve-sided light, having the axes of the panels at unequal intervals of azimuth 15 deg. and 45 deg. alternately.

It will be seen from Fig. 3, which is a horizontal section in the plane in which the axes of the principal lenses lie, that the panels are unsymmetrical, their axes not being central to their width, so that they are alternately closer together and farther apart, and by this means the required angles in azimuth are given to the flashes, and to the short intervals between them. As this apparatus is carried round by clockwork at a speed of one revolution in six minutes, which is at the rate of one degree of azimuth per second of time, and as the axes of the dioptric panels are alternately 45 deg. and 15 deg. apart, being arranged in pairs, it follows that a double flash will meet the eye of an observer once in every minute. He will see a flash of about 4¼ seconds' duration, followed by about 10¾ seconds' darkness, then another flash of 4¼ seconds, and this double flash will be separated from the next by an eclipse of about 40¾ seconds. As each panel condenses 30 deg. of the light of the flame into 4 deg. in azimuth, it gives an intensity to each flash represented by 7½ (the continuous light of a fixed apparatus being taken as unity). In the ordinary eight-sided revolving light, 45 deg. in azimuth is condensed into 4 deg., so that the intensity of its flash would be about 11¼, but as the two flashes near to each other are almost as convenient for taking a bearing as a continuous flash would be which lasted from the beginning of the first flash to the end of the second, the time available for taking a bearing may be taken as of 19¼ seconds' duration, which has great advantage over the eight-sided light, notwithstanding the slight superiority in the intensity of the latter. The distinctive character of this light consists not in the precise periods between the flashes, but in the flash being a double one, and as the two flashes are of exactly the same power the general appearance of the light must be always the same. We give a general view of this beautiful apparatus taken from a photograph.

The mechanism by which the system of prisms and lenses is driven round, at a speed of ten revolutions per hour, possesses several points of special interest. In it has been adopted the ancient driving and maintaining power of Huygens, which depends for its action upon the differential effect of two unequal weights upon an endless chain passing over the driving wheel of the apparatus. Its characteristic ad-

Fig. 3.



vantage is that the driving power is maintained during the time that it is being wound up, and at the same time ratchet-wheels, such as are employed in other arrangements, can be dispensed with. The general principle of Huygens' maintaining power is described in most works upon horology.

Dr. Hopkinson has also introduced an exceedingly simple governor for regulating the speed of the apparatus. It is furnished with two balls mounted in a similar manner to those of an ordinary steam engine governor, but their action on flying out is to raise a large disk revolving with the same spindle, so as to bring it into frictional contact with a rubber whose distance can be regulated by a screw adjustment. This disk has such complete control over the driving machinery that the whole can be stopped by a small mill-headed screw, which by being turned presses against the edge of the disk and stops it by its friction.

The source of illumination is one of Mr. J. N. Douglass' first-order lamps. It consists of a large cylindrical reservoir of brass capable of containing several gallons of oil and provided with simple apparatus by which the oil is raised to the wick-holders. Above this is the burner, made up of six concentric wicks, each of which can be raised or lowered by a rack and pinion turned by a milled head which is marked with a number corresponding to the wick to which it belongs.

Hitherto the lamps for dioptric apparatus of the first order have been provided with four concentric wicks, all of which have been in use in all weathers. In Mr. Douglass' improved lamp, the three inner wicks can be shut off by a metallic cover and cone when the weather is clear, and the lamp is only burned at full power in thick weather when greater penetrating power is necessary. The full light-producing power of the lamp when all the wicks are in use is equal to 772 standard sperm candles, and at this power it consumes one gallon of oil in one hour and fifty minutes. With the three wicks its consumption is one gallon of oil in two hours and forty-five minutes, and its light is equal to 342 candles.

With this apparatus any description of oil, whether animal, vegetable, or mineral, may be burned, as it is provided with a simple contrivance whereby the level of the oil in the wick-holders is regulated, and also the admission of air to the flame. When arranged for burning sperm, colza, or cocoanut oils, the oil is allowed to overflow the wick-holder, the unburnt portion flowing back to the reservoir; but when mineral or equally inflammable oils are employed, the flame is supplied by the capillarity of the wicks. It has been found from experiment that by this improved lamp the illuminating power has been increased as much as 22 per cent., while the consumption of oil has been reduced 17 per cent. At the Little Basses Lighthouse the illuminating agent is the local cocoa-nut oil, which is found to be nearly equal to the best colza.

The lanterns of both the Great and Little Basses are on the Trinity House cylindrical pattern, having helical gun-metal framing inclined at an angle of 60 deg. with the horizon, and which supports the diamond-shaped panes of glass; these are bent to the cylindrical curvature of the lantern, so that the rays emanating from the dioptric apparatus fall normally on their surface, and thus both internal surface reflection and aberration due to refraction are prevented, and at the same time the maximum strength is given to the structure.

The system of ventilation is that arranged by Faraday, and which is now universally adopted. The importance of a perfect system of ventilation can hardly be over-estimated, as without it not only is it impossible for the lamp to give its full light, but condensation takes place upon the inner surface of the glazing of the lantern, and the efficiency of the light is most seriously impaired.

The cost of the Little Basses Lighthouse is estimated at about 73,000*l.*, which sum includes all expenses of carriage from this country and delivery in Ceylon, as well as the screw steamers by which the work was carried on. These sums compare per cubic foot most favorably with the costs of rock lighthouses built near our own shores, notwithstanding the great increase there has been in the value of both labor and material.

It has been estimated, as a consequence of the erection of the first of the two lighthouses on these dangerous Cingalese shoals, that the voyages of passing steamers have been so shortened that the saving in coal alone, irrespective of that of time, wages, and interest on capital, has already exceeded the cost of its erection, and there can be little doubt that, when the second is completed, this saving will be still further increased and the risk of life from shipwreck in these waters will be reduced to a minimum.—*Engineering.*

THE SOUTER POINT ELECTRIC LIGHT.

A VISIT to the great electric light at Souter Point, three miles below the mouth of the river Tyne, Eng., is described by Major George H. Elliot in his report on the European Light-house system. He gives the following particulars:

On both banks of the river, from the mouth to Newcastle and beyond, there is an immense number of manufactories of all kinds, and their smoke hangs over the river like a cloud.

Fogs on this part of the east coast of England are also frequent, and as they mix with the smoke, the problem of light-house illumination of the sea near the mouth of the Tyne is one of great difficulty.

To meet it, an electric light was constructed at Souter Point a few years ago, and it is without doubt one of the most powerful lights in the world.

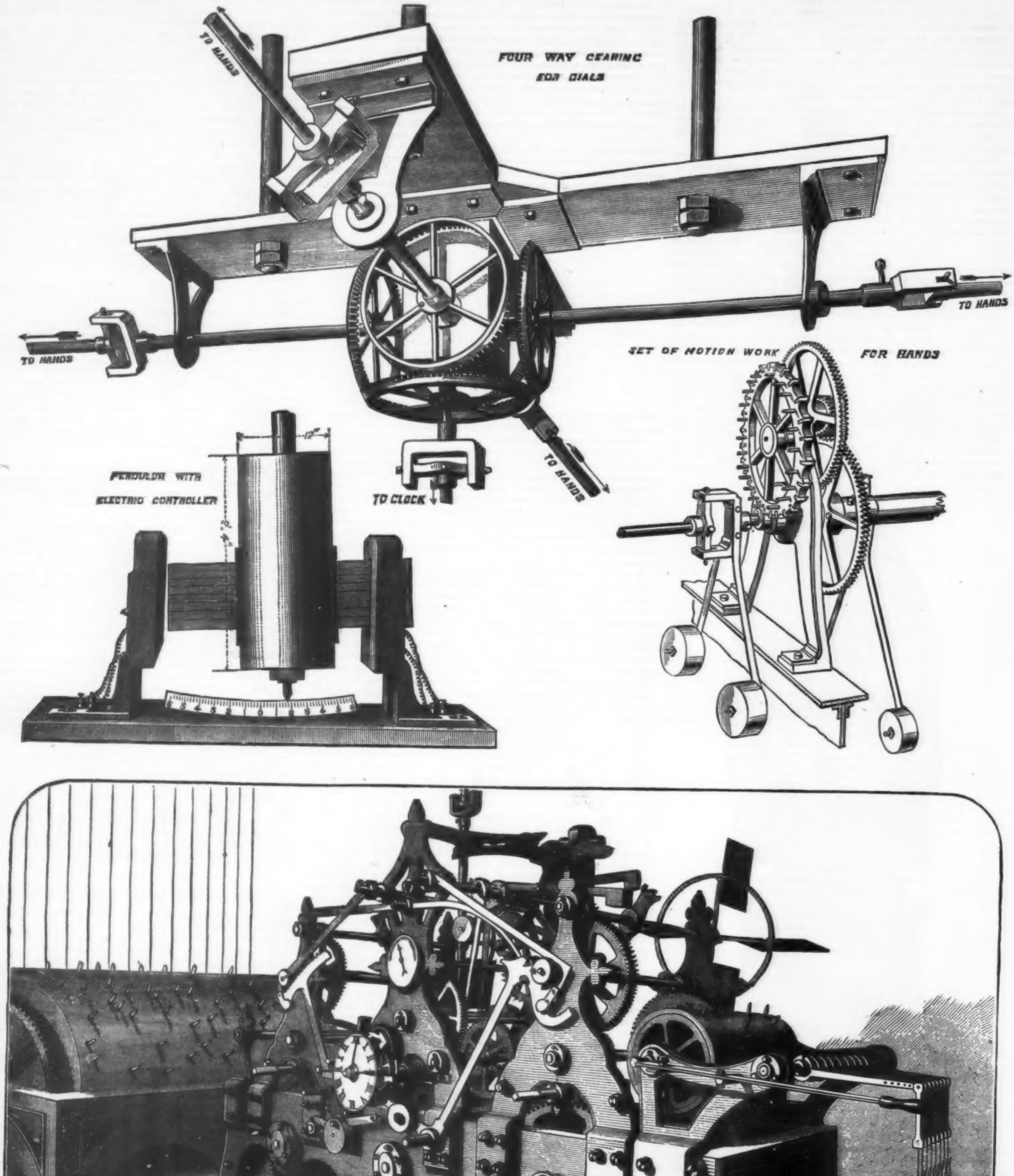
The condensed beams from the most powerful fixed and flashing first order sea-coast lights of England (with the Douglass four-wick burner, the illuminant being oil) are respectively equal to 9,000 and to 111,000 candles (ours are much less), while the condensed beam of the flashing electric light at Souter Point (assuming the power of the lens, as calculated by Mr. Chance, to be 196 times as great as the power of the unassisted light) is equal in power to 800,000 candles!

The lens at Souter Point is of the size of those of the third order, or 39.38 inches in diameter, and consists of a fixed-light apparatus covering the sea-horizon, *i.e.*, 180°, and is surrounded by eight panels of vertical condensing-prisms, which in their revolution give flashes at intervals of one minute.

The machinery for generating the electric current is similar to that of South Foreland. Two rotary magneto-electric machines of Professor Holmes' patent are driven by two 3 horse-power engines which can be worked up to 6 horse-power each.

The number of revolutions made by each machine per minute is 400, and as 16 sparks are produced by each magnet at each revolution, the number of sparks at the carbon points of the lamp is 6,400 per minute, when one machine only is in operation, as is the case in fair weather, and 12,800 per minute when both machines are at work. These sparks are formed so rapidly that the eye does not separate them, and the result is a continuous beam of light, so dazzling that the eye of a person within the lantern cannot rest upon it for an instant without intense pain.

The electric lamp, as at South Foreland, consists mainly of two carbon points, each about ten inches long by one-half an inch square in section, placed end to end in a vertical position, and the automatic machines called regulators, feed the points toward each other as fast as they are consumed, which is at the rate of one inch per hour each.



NEW TURRET MUSICAL AND CHIMING CLOCK, FOR BOMBAY UNIVERSITY

NEW TURRET, MUSICAL AND CHIMING CLOCK.

WE illustrate this week a turret, musical and chiming clock, constructed for the new clock tower, Bombay University, by Smith & Sons, St. John's square, Clerkenwell, London, which is, we believe, the largest eight-day clock in existence. It will show the time on four illuminated dials, 12 ft. 6 in. in diameter, which are a great deal too small considering the elevation of the clock above the ground. There are in all fifteen bells, and the quarters are chimed either on four or eight bells at will, while the carillon plays tunes on fifteen bells. The clock is capable of getting the full tone out of a 3-ton bell.

The framing is of horizontal type supported on a massive iron bed; the length is 13 ft., width 4 ft. 6 in., and height 8 ft., and the whole clock weighs over 3½ tons; the wheels and boxes are all of gun metal, the main wheels being 2 ft. 6 in. in diameter; the pinions are cut from the solid and polished, the escapement is Graham's dead beat with jeweled pallets, and the pendulum is compensated with zinc and iron tubes. The bob weighs 6 cwt., and the pendulum beats two seconds. An electrical controlling apparatus to govern clock from Colabra Observatory is added. This controlling gear is shown above, and is extremely simple. It consists of electro-magnets, magnetized and demagnetized at will, so as to control the time of oscillation of the pendulum and alter its time by minute intervals. In this way a remontoire or a gravity escapement has been rendered unnecessary, as the clock is really compelled to keep time with the standard regulator at the observatory. Our detail engravings show the leading-off works to the dials with the universal joints for the hand axles.

The striking gear is of the rake and small type. Jacks are provided for winding, and second, minute, and hour dials, for regulating inside. The chimes are to be altered from the "Westminster" to a changing run on eight bells at pleasure, provision being made for throwing the barrel in and out of gear, and a double set of hammer tails or levers is provided. The tunes are played by one of the old type carillon barrels, which is shown at the end of the clock in the background of our engraving. The shifting work for the musical part is an irregular seven days' cam or snail fixed on the clock and cut to suit the various times the tunes are to be played; this cam or snail also discharges the tunes.

The bevel wheels to connect the clock motion works are of gun metal, supported upon iron frames; the wheels 15 in. diameter; the motion wheels are 19 in. diameter, all of gun metal, and the spindles work on friction rollers, and the hands are of double convex copper, very strong and light.

The dials, of which Messrs. Smith & Sons are the inventors, have outside wrought iron rings, 4 in. by ½ in. bent edgeways. Copper moldings and copper figures are added, and the dials are glazed with best opal glass. Being made in this way the dials are at once very strong and very light, and the illumination very distinct, as the figures project but a little from the glass, and consequently throw no shadow upon it.
—*The Engineer.*

SYMPATHETIC VIBRATION.

A LECTURE on this subject was lately delivered at the London Institution by Professor Barrett, of Dublin, before a large audience. By means of an extensive array of apparatus and diagrams, several beautiful specimens were given in illustration of the lecture. In order to show how a sympathetic body may be profoundly affected by another, one of a set of three pendulums, suspended from a horizontal bar, was set in motion, and speedily communicated motion and energy to the second, until its own energy and motion were absorbed, and it became motionless, when the second recommunicated motion and energy until it, too, was exhausted, only to be in a less and less degree revived. The third pendulum being of shorter length, and therefore out of sympathy, remained passive. An illustration was also given by a flame peculiarly sensitive to hisses, though indifferent to applause, the utterance of the sibilant by the lecturer or audience immediately producing a perfectly sensible flicker. The same flame responded to the ticking of a watch. The lecturer, in conclusion, argued that the lesson taught was, not to dogmatize in a universe of which we knew so little.

ARCHITECTURAL SCIENCE CLASSES.

ELEMENTARY REPLIES.

QUESTION.—*How much less weight will a beam carry supported at ends and loaded in the middle than it would do if the load was distributed?*—A beam will carry exactly twice as much if the load be distributed than it will if loaded in the center. By the following table and rule a safe permanent load may be found:—Teak, 273; ash, 225; Canadian oak, 196; pitch pine, 181; red pine, 149; English oak, 133; Riga fir, 125; larch, 93. To find the safe load if loaded in the center, multiply the number given in the table by the square of the depth in inches and by the width in inches, and divide by the length in feet. Example: A beam of pitch pine, 20 ft. long by 12 in. deep, and by 8 in. wide—what weight, loaded in the middle, will it carry? $\frac{181 \times 144 \times 8}{20} = 10{,}425\frac{3}{5}$ lb.; or, if equally distributed, $10{,}425\frac{3}{5} \times 2 = 20{,}851\frac{1}{5}$ lb.—WILHELMINUS.

QUESTION.—*Show how the strain is calculated?*—The strains on beams can be calculated by means of trigonometry; but a more direct way, and, for ordinary purposes, quite as exact, is to apply the graphical method. To find the strains graphically on a beam supported at both ends, with a fixed load, draw a vertical line from the point of greatest strain, making it (by some convenient scale) equal to the strain; connect the top of this line by straight lines with the ends of the beam; then the strain at any point may easily be found by drawing an ordinate from that point, and the magnitude of the strain will be represented by the same scale as that employed in drawing the vertical line. When the load is distributed, instead of being simply concentrated at a given point, a parabola must be drawn through the three points, having the top of the vertical line for its vertex: and the strain can be computed by means of ordinates, as above described. The center strain of a beam supported at both ends, with a center load, is found by the formula, $\frac{1}{4}\,w\,.\,l$, and the center strain of the same beam with a distributed load is $\frac{1}{8}\,w\,.\,l$—w being the load, and l the length in feet of the span.—T. N.

QUESTION.—*What advantage is gained by fixing the end of a beam?*—The advantage that would be obtained if the ends were fixed would be that it would carry half as much again than if the ends were not fixed. Thus, if a beam would carry 2 tons when the ends are not fixed, it would carry 3 tons if fixed.—R. J.

ADVANCED REPLIES.

QUESTION.—*Explain concisely the theory of the transverse strength of a beam.*—The theory of the transverse strength of a beam is founded on the relation that exists between the load acting with a certain leverage, called the "moment of weight," and the *resistance of the fibres* of the material acting with a certain leverage—determined from the neutral axis of the beam—called the "moment of resistance." This last resistance can be found by multiplying the tensile or compressive strain per square inch by the moment of inertia of the beam, and dividing by the distance of the fibres farthest from the neutral axis. The value of the moment of inertia varies for different sections, and may be found in books of reference. For a beam to be in a state of equilibrium, or just on the point of breaking from the load, the two moments above defined balance or equal one another. So that the strength of a beam depends entirely on the moment of resistance being greater than the moment of the weight—in fact, an the proportion the former bears to the latter.—H. G.

QUESTION.—*Give the rules for finding the strength and stiffness of beams.*—Timber W = breaking weight in cwts., B = breadth in inches, D = depth in inches, L = length in feet, C = constant, varying from 6 English oak to 3 for Riga fir. Supported at both ends, loaded in the center, $W = \frac{B\ D^2}{L} \times C$, safe load should not extend to the breaking weight. If the weight be distributed the beam will carry double the above. For stiffness in timber beams the proportion of breadth to depth should be as 1 to 1·732. This may be geometrically set out by marking off the radius of a circle on its circumference, and joining the four corners.—PRO REGE ET LEGE.

QUESTION.—*Give the rules for finding the strength and stiffness of beams.—[Another rule.]*—To find the strength of a rectangular beam, fixed at one end and loaded at the other. Rule: Multiply the value of the strength of the timber used by the area of the section and by the depth of the beam, and divide the product by the length in inches; the quotient will be the breaking weight in pounds. In the following examples the timber to be used is Riga fir, and the value of the strength is as quoted by Barlow. Example: A beam of Riga fir projects 10 ft. beyond its point of support, and its section is 8 in. × 6 in.; what is its breaking weight? Area, 8 × 6 = 48; multiplied by the depth, 8 = 384. Multiply this by the value of the strength, 1108, and divide the product by the length, $\frac{1108 \times 384}{120} = 3545$ lb. The fourth part of this is the safe weight for practice, $\frac{3545}{4} = 886$ lb. To find the strength of a rectangular beam. Rule: Multiply the value of strength by four times the depth and by the area of the section in inches, and divide the product by the length between the supports in inches, and the quotient will be the greatest weight the beam will bear in lbs. Example: A beam of Riga fir is 26 ft. long between its supports, and its section is 8 in. × 6 in.; required, its breaking weight? The value of strength is as before, $\frac{1108 \times 8 \times 4 \times 8 \times 6}{240} = 7091{\cdot}2$. The 4th part of this is the safe load; therefore $\frac{7091}{4} = 1772$ lb. —ATTNEAVE.

QUESTION.—*Show how the strength of an inclined rafter may be determined.*—The formula usually employed is, $W = \frac{\left(\frac{B\ D^2}{L} \times C\right) L}{H}$, when B = breadth in inches, D = depth in inches, L = length in feet, C = Constant, same as for ordinary beams, H = horizontal distance in feet, W = equal breaking weight in cwts.; or, in words, inclined beams have their breaking weight equal to that of the same beam when horizontal, multiplied by the length of the beam, and divided by the horizontal distance.—PRO REGE ET LEGE.—*Building News.*

HOW THE CENTER SELVAGE IS FORMED.

THE center selvage is a very good substitute for the real selvage where great strength is not required; and is a means by which two or even three breadths of narrow cloth can be wrought in a broad loom at the same time. The cost of production is thus lessened, and the turn off greatly increased. This method of weaving can be taken advantage of in some sorts of bagging, where the selvage is sewn in, as also in cloth used for various purposes which we need not here particu-

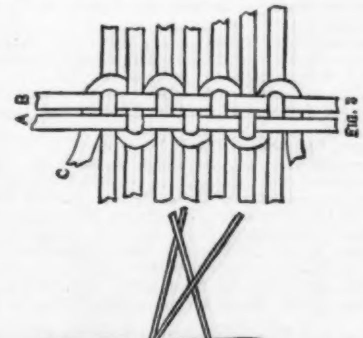


FIG. 3

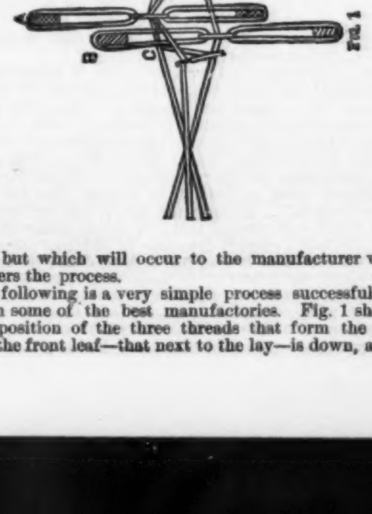


FIG. 1

larize, but which will occur to the manufacturer when he considers the process.

The following is a very simple process successfully practised in some of the best manufactories. Fig. 1 shows the exact position of the three threads that form the selvage when the front leaf—that next to the lay—is down, and Fig. 2 when the back leaf is down, and Fig. 3 is an enlarged view of the selvage itself, showing how the three warp threads are combined with the weft to form the selvage. It will be seen that the whole thing depends on the looping thread C, which in a very ingenious though simple manner combines the weft and warp threads together. On the tension at which this thread is held depends the strength and compactness of the selvage. This thread comes directly from the bobbin on which it is wound—placed in some convenient position at the back of the loom—to the back leaf, and passes through the same heddle with one of the other threads, A or B. The looping heddle C is then mounted on the front leaf, and the thread also drawn through it. Great care is necessary in regulating the length of this heddle, in order to make the most of both sheds, as it cannot rise much above the center of either. It will also be observed that this thread is always above the weft thread, and goes through below the two warp threads between each pick, and thus draws them altogether.

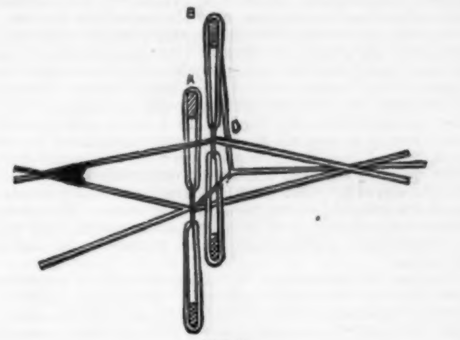


FIG. 2.

The bobbin on which the thread is wound is paced by weights to keep it at the proper tension.

An empty split is left between the selvages of the two pieces of cloth to guide the knife in cutting them up after they have left the loom. We may also add that the mail or ring of the looping heddle, through which the thread passes, must be of such shape and dimensions as will prevent its getting entangled in the splits of the reed. Some little difficulty is sometimes experienced by beginners in mastering the details, even simple as they are, but a short time overcomes this.—*Textile Manufacturer.*

THE CARPET MANUFACTURES OF PHILADELPHIA.

THIS most important industry has continued to hold a leading position in Philadelphia, though suffering under the general influence of the prevailing business depression. The amount of machinery employed, and the number of persons engaged were never so great, but a large share of the looms have been idle at intervals, amounting perhaps to one fourth of the time. By a careful census, taken in July, there were 180 establishments, 592 power looms, 3,517 hand looms, and 7,325 persons employed in this manufacture, exclusive of two or three factories of hemp or jute carpets, and of thirty-five or forty establishments weaving worsted and rag carpets. The production of these regular ingrain and other wool carpets was 370,400 yards of tapestry, 900,000 yards of Brussels, 6,018,900 yards of all-wool ingrain, 12,135,400 yards of wool and cotton ingrain, 1,582,206 yards of Venetian, and 1,894,836 yards of damask; in all, 22,902,836 yards, valued at the low wholesale prices then prevailing, as calculated in detail for each grade, at a total of $13,929,392. The large proportion of these carpets, sold by the manufacturers direct to consumers, realizes for them more than the minimum price taken for these calculations, and the whole industry is really worth, other forms of carpet included, between fifteen and sixteen millions of dollars for the year.

As is the case with most other industries, this manufacture of carpets is an indigenous growth in Philadelphia, rising from small beginnings, and the hundreds of establishments are the personal property of those who conduct them, representing the profits of years of patient industry. Nothing is to be paid out of the business of any year to represent borrowed capital or shares held by others. While active and employed profits are certain, and while temporarily suspended there is little or no loss. The advantages of this easy condition are very striking at such a time as the present, enabling them to endure the partial suspension without material injury to any of the persons concerned. Accustomed to thrift and economy in management, there is no business more independent of temporary depression, or more secure against loss and poverty, as to both employers and employed, than the carpet manufactures of Philadelphia.

During the last year great progress has been made in the introduction of better machinery, and now there are the most perfect looms engaged on all the higher grades, and at least one large establishment with a capacity for producing fine goods, scarcely inferior to the best in England. This establishment has 250 power looms, working an immense stock of wool of the best qualities produced in Russia and in the southwestern plains of the United States—the two great sources of long stapled wool suited to the best carpet worsted. About twenty establishments work from ten to sixty power looms each, with an equal number of hand looms in each case. The aggregate number of steam engines is thirty, with a total of 1,572 horse-power, and 61 sets of woollen spinning machinery. Much of the carpet yarn, both worsted and cotton, is spun in establishments which do no weaving, and are not included in this calculation.—*North American Supplement.*

DIRECT POSITIVES FOR ENLARGING.

WE have seen transparencies produced in the camera possessing such great sharpness as to bear being enlarged three or four diameters without *practical* loss of definition. The way to proceed is to use bromidized emulsion plates. Give a good exposure, and develop with an alkaline pyrogallic solution. After washing, pour nitric acid on the surface, by which the negative will be converted into a positive or transparency, owing to the dissolving away of the silver which formed the negative image. Now wash, and again apply the alkaline developer previously employed, and which should be retained in the cup for this purpose; hold the plate in the light for a few seconds, and a very rich and finely toned transparency will reward the slight amount of trouble thus taken. The sharpness will be sufficient to admit of the details being examined under a microscope.—*British Journal of Photography.*

WATER GAS AND ITS ADVANTAGES.

RECENT articles which have appeared in this and other scientific journals upon the advantages of a gaseous fuel, have been so extensively and favorably commented upon by the general press as to indicate a gratifying popular interest in that important subject—an interest which calls for a more comprehensive statement than has yet been submitted. Indeed, it is a topic which may well attract all classes of minds, opening, as it does, numerous and subtle questions to the analyst, and touching the interest not only of every manufacturer and mechanic, but of the humblest housekeeper as well.

In fact it may be claimed that the utilization of heat is a fair gauge of the progress of civilization, and in this sense no single object in the great Exposition more strikingly symbolized the refinement of the present century than the great Corliss Engine whose iron sinews gave activity and use to ten thousand mechanisms. Unhappily it illustrated also the great defect of our present fuel system, by the immense waste of the heat-power from which it derived its motion.

Why this occurs and how it may be partially remedied, this article will attempt to explain. At the outset, let it be distinctly stated that the writers—who treat this subject as "Gas *vs.* Coal"—do not put it quite fairly, because though a comparison lies between the two *forms*, on economic and other considerations, the fuel is, in a sense, one and the same; that is to say, all the heat-energy contained in the gas is derived from the carbon of the coal, and hence there is no quarrel with the latter, but only with the present wasteful use of it. The black diamond will still maintain its value among the crown jewels of civilization. For an intelligent understanding of this subject let us take up this question of loss, and ascertain, as far as may be, its extent and causes.

The loss is attributable to natural difficulties attendant upon the use of a crude material. As combustion is the union of combustible elements with oxygen with the development of heat, it is manifest that if these different elements exist in such form as to require any expenditure of heat to prepare them for such union, just that proportion of heat is rendered unavailable for other purposes, and is, in that sense, lost. For example, with all their strong affinity, O. and C. as they exist, the one in water or air, and the other in coal or oil, cannot unite perfectly until some power has been exerted upon them sufficient to change their solid or fluid forms to gaseous ones; and this expenditure of power is just the measure of this particular loss in the combustion of coal in atmospheric air. The theory being that the dynamic force must be great enough to separate the atoms of the different elements operated upon, and so prepare them to coalesce with others with which they are in affinity, it is evident that the energy required to burn the diamond is immensely greater than that necessary to ignite charcoal, although these two substances are substantially carbon in different degrees of density. It is not surprising then, when the compact, mineral structure of coal is considered, that a large expenditure of heat is requisite to divide the molecules and enable them to reach a condition in which to form union with the oxygen of the air. It may be remarked also, in passing, that as this converting process is exerted upon the surface of the solid material, thence extending gradually inward, encountering ash and other foreign substances, the operation is by no means uniform, and this contributes to an imperfect combustion, and consequent waste.

But a still more important source of loss, and one apparently beyond remedy by any means in present use, is chargeable to the bad company which oxygen keeps. For every volume of this gas the atmosphere contains four volumes of nitrogen, which being a non-combustible gas, interferes with the union before described, and retard it.

Allusion is not made now to the divisory influence which nitrogen necessarily exerts in the final combustion in atmospheric air by which it abstracts heat somewhat in proportion to its volume—a loss which though considerable is inevitable—but to the antagonistic action of that amount of nitrogen which in the stages preceding or incident to partial combustion, by mingling with the gases desiring to unite, so far dilutes a portion of them as to render them for the time being non-combustible, so that while in that condition they are swept out of the area of flame and wasted.

An even more important loss is traceable to the fact that a portion of the products of combustion which float out from the fire chamber unburnt, are not only combustible, but are *especially valuable* for combustion, and these frequently pass into the atmosphere a total waste of calorific ingredients, besides absorbing and diverting, like the nitrogen, an important amount of heat. A familiar illustration of this waste is seen in the flames rising from the tops of blast furnaces, composed largely of carbonic oxide, which, though one of the most combustible of gases, is yet unable to burn in the fire chamber, where it was generated, for lack of oxygen, and passes up to the chimney top, where, meeting this element in the air, it ignites. This particular wastage attaches in greater or less degree to almost all the methods in use, and it was this fact that led to the invention by that eminent metallurgist, Dr. C. W. Siemens, of the gas furnace which bears his name, and which ranks as the most economical and efficient system in use. It is, in brief, a producer wherein coal is burnt with an air blast, the products of partial combustion being conducted thence into a furnace and there burnt in lieu of the coal itself. In other words, the system barters the direct use of the coal for the partial gaseous products ordinarily wasted, and claims to make a decided gain by the exchange. Its defect lies in the fact that the gas so made contains the heavy proportion of nitrogen consequent upon the use of air, this amounting to two-thirds of the whole volume (beside the amount yet to be taken up in combustion), and reduces its calorific value in the manner already explained. If then, his system is an economical one, what must be thought of the more extravagant ones in general use?

Another cause of loss in the burning of crude fuels, and one of sufficient importance to deserve mention, is the fact that there is mixed with the carbon a considerable quantity of foreign matter not combustible, which absorbs heat and gives no equivalent. This is represented principally by the ash and clinker, which every consumer of coal knows to be a large item. It reaches from 10 to 15 per cent. of the material paid for. To illustrate the difficulties attending the use of a crude form of fuel, let us take the most familiar methods, such as are employed in domestic cooking and heating.

Ignoring the mechanical imperfections of stoves and furnaces, lest an examination into them should extend this article unduly, we will examine the more evident sources of loss:

a. The expenditure of fuel in generating heat at times when it is not utilized. Every housekeeper must have been struck with the fact that a large amount of wood and coal is burned before the range is ready to cook, and that a probably larger amount still is used after the cooking is done. Annoying as this may be, it is cheaper to keep the fire up between meals, even in summer time, when it is undesirable, than to let it go down and rekindle three times.

b. The *excessive quantity* employed while in use. Often to accomplish some trifling result like the boiling of a teakettle, the whole area of fire space is necessarily kindled though not more than one-tenth of it is required. Twenty lb. of good anthracite coal contains heat-energy sufficient to raise 270,000 lb. of water one degree in temperature, or 1,776 lb. from 60° F. to the boiling point, 212° F., and yet it is to be feared this power is frequently employed in cooking a pot of coffee. If we have expended for our morning draught heat enough, if perfectly applied, to raise ¾ ton of the same liquid from atmospheric temperature to boiling point, it may be considered a somewhat luxurious beverage.

c. The items of labor and inconvenience incident to the use of coal are too apparent to need any enlargement.

These are the principal arguments against the general use of fuel in its natural condition, and they appear formidable enough to justify the assertion that not over ten per cent. of the heating power of such fuel is utilized.

Let it be remembered that it is in all cases *gas only* that we burn and from which we derive heat, so that the question is really whether each family can make a limited quantity of the gas as economically and successfully in very defective ranges stoves, as the same or a much better article can be manufactured on a large scale at some great establishment, whence it could be distributed to consumers. There can be no doubt that the advantage possessed by all concentrated industries exists in this one to at least as great a degree as in any other department of manufacture. We might as reasonably expect to grind our own flour, or weave our own fabrics economically, as to successfully compete with large gas-works properly constructed and skillfully managed.

The advantages connected with the use of a gas-fuel may be enumerated as follows:

a. The cost, labor and inconvenience of handling a heavy material is avoided, the fuel being capable of easy distribution.

b. It is a form, also, free from those material impurities which involve a large residual waste, besides impairing combustion.

c. It is free also (if it be a purely combustible gas) from those ingredients which, in the present methods of heating, involve even larger loss than the cause last mentioned.

d. It is in precisely the condition to unite perfectly and instantaneously with the oxygen of the air, thus securing a thorough combustion.

e. Hence it gives an immediate and uniform result, and its flame temperature is constant.

f. The intense and steady heat of the flame just mentioned saves both time and money, by presenting an even fire surface ready at the moment of ignition.

g. It is a fire capable of concentration upon the precise point where the result is desired, and one that is thoroughly under control, the turning of a valve starting, graduating or stopping the combustion at will.

h. The general cleanliness of the system, no dirt or residuals being left.

i. The decided advantage from a sanitary standpoint of simply *burning* combustible gases in our dwellings, instead of attempting to *make* them as well, by means of the imperfect gas machines called stoves. In the one case the only risk arises from the possibility of a leak, readily detected by the sense, and having simple mechanical remedies; in the other it is a much more serious risk, because the defect is a chemical one, consequent upon imperfect combustion, and the infusion of a poison into the atmosphere is likely to be frequent and insidious, to say nothing of the deoxidation of the air by contact with red-hot iron surfaces. The reduction of this particular danger is about in proportion of the greater completeness of the combustion of the more refined fuel.

These facts appear to be overwhelming arguments in favor of a gaseous, as against a gross form of fuel, and lead to the inquiry, what gases are available for such purposes?

The ordinary coal-gas made for illuminating purposes possesses some of the requisite qualities. It is a combustible gas of great purity, of sufficiently low density to render its distribution easy, and with a high flame temperature; but, *per contra*, the constituents which impart the illuminating power are expensive, while entirely unnecessary for fuel purposes. And yet, high-priced as it is, practical experience in its use proves that, in some departments at least, it is certainly cheaper than coal, beside its collateral advantages, and it is at the present time employed, to a limited extent, by those who have become familiar with the facts. Exceedingly interesting tests have been made by the London engineers with city gas, developing some economic features in the matter, quite surprising; and at the meeting of the American Gaslight Association, in October last, a paper was presented by one of the members, showing that careful experiments had so thoroughly demonstrated its saving, even at $3.60 per 1,000 cubic feet, that nine-tenths of his customers were using it in preference to wood or coal for kitchen and laundry purposes.

Nevertheless, coal-gas can hardly be expected to offer, for general use—domestic and industrial—a substitute cheap enough to supplant coal. Something at a still lower price is needed. Such gas as is made by the Siemens process, before alluded to, has the advantage of cheapness, so far as the mere relation of cost and quantity is concerned, as it can be produced at about 15c. per 1,000 feet, but its composition is not favorable. It, in fact, contains less than 30 per cent. of combustible gases, the remainder being worse than useless, beside rendering it too heavy for ready distribution at long distances.

A water-gas, that is, a gas resulting from the decomposition of steam by contact with burning carbon, if it can be made cheaply, possesses those very qualities most desirable in a fuel, viz., inflammability and intensity.

Composed of hydrogen and carbonic oxide, it is free from the undesirable element nitrogen, and what advantage lies in that single fact it is hoped the foregoing explanation may have made measurably apparent. If carbonic oxide, representing the maximum flame intensity (among practical gases), and hydrogen with but little less of this quality, and an even "greater useful value," as Percy expresses it, do not furnish the very highest order of fuel, then science does not yet know where to seek it. Fortunately, too, it is a fuel obtainable at the lowest cost, though this is a recent achievement. For more than half a century inventors of different nationalities have racked their brains for some method by which water-gas could be produced in large quantities inexpensively for the industrial arts, but various defects have invariably attached to the systems proposed, and rendered them unsuccessful.

At last, however, to reward the pertinacious effort, full success has been reached, and the Lowe process accomplishes efficiently and economically what has so long been sought.

It requires the outlay of great potential energy to release the hydrogen of water, but the Lowe apparatus, by a system at once original and simple, generates a concentrated and sustained heat which does the work with a facility that is astonishing, yielding a volume of 50,000 feet for a ton of coal burned.

The Lowe process, in the three stages of its operation, fairly illustrates in itself all the different methods employed in combustion, and these represent an ascending scale of excellence. The generator, wherein the coal is burned, stands for the old-time principle of the stove or furnace, giving off its products of combustion. The super-heater, as the second chamber is called, into which these products are led and burned without other fuel, very perfectly represents the improvement accomplished by the more modern Siemens and Whitwell systems. The third operation shows the latest and highest method, to which the two others are preliminary and subordinate. After the coal has become thoroughly ignited, the atmospheric air is shut off and a new atmosphere of steam is introduced. This furnishes oxygen as the other did, but happily excludes the mischief-making and non-combustible nitrogen, and substitutes for it the most highly inflammable gas known, hydrogen—a most valuable exchange certainly in view of the fact that the result shows a product to the ton of coal, possessing some four times the calorific value of that by the Siemens process.

Here, then, would appear to be a gas in which all the essentials unite for a fuel fully up to the demands of the present civilization. A fuel adapted to universal use, because the materials for its production are everywhere present, water and carbon being accessible to all localities,—the former in costless abundance, a constant element, the latter though in varying form, as coal, wood, peat, etc.

Sweden, famed for her superior iron, imports the coal with which to work it, while underneath her soil lie millions of tons of peat, capable of coking, and in that form generating water-gas.

Along our own Pacific slope the miners are baffled by the refractory nature of many of the ores, yet the wood of the forests might be employed in the production of this fuel gas, before whose intense heat the stubborn minerals would quickly yield their treasures.

There is no more doubt that water-gas is to inaugurate a new and wonderful development in the domestic and industrial arts than that there is hydrogen in the sun. It is the "fuel of the future," and the not distant future. It stands ready to contribute new energy to civilization, and the age is prepared for it. GEORGE S. DWIGHT.

BRATTICE CLOTHS.

MR. W. H. JOHNSON lately exhibited and described to the Manchester Geological Society, Eng., several samples of a new kind of brattice-cloth, composed of wire-cloth instead of the ordinary material. There was, he said, some 36 holes to 1 in. in the cloth, and the wire was extremely fine, almost as fine as any iron wire could be drawn, and the advantages connected with this cloth would be that it would be much more durable than the present form, and that it would be much less inflammable. Experiments had been tried with the cloth, which showed that it would require an intense heat to burn it through, and that it was almost absolutely water-tight. Some of it had been exported for use as brattice-cloth in foreign mines.

In the discussion which followed, Mr. Dickinson said the great points for consideration was—first, cheapness; second, durability; third, portability; and, fourth, non-inflammability. This cloth might possess some of these advantages. It would not be so cheap, but it would possess great non-inflammability, and also a great amount of durability. This latter point was a very important feature, for they knew by experience in that district that sometimes after an explosion the brattice took fire and ignited the coal. Then, again, the portability of brattice cloth was a very important matter, and this cloth from its thinness might be more portable. If the cloth which Mr. Johnson had showed them possessed the four advantages he had named—cheapness, durability, portability, and non-inflammability—there would be no difficulty in getting it adopted in that district.

Mr. Johnson said, with regard to Mr. Dickinson's observations, he might state, that when the cloth was held in a flame it burned, but it would not continue to burn of itself like ordinary cloth. As far as its bulk was concerned it occupied much less space than the ordinary brattice.

Mr. J. H. Johnson observed that this new brattice was almost six times the price of ordinary brattice, and he thought the ordinary brattice coated with alum would act almost as well.

Mr. Grimshaw said he had tried several of the non-inflammable cloths, and most of them had some drawback. There was one which was extremely stiff, and broke when it was folded. There was another which was coated with a poisonous matter. This acted very well in a dry mine, but in a damp mine if anyone rubbed against it with their bare flesh the poisonous matter came off and gave them something very like the small-pox. He should be glad to know of a non-inflammable brattice cloth at a reasonable price which would be as good as the ordinary brattice cloth. The ordinary brattice cloth cost 7d. to 8d. per yard, but he thought that the cloth exhibited at 4s. would hardly suit this country.

Mr. Aitken observed that the great advantage of this cloth was its indestructibility. In the case of an explosion, if the brattice cloths were kept in their place, it seemed to him that the currents of air would be kept up much better, and the mine would be much sooner cleared of gas. That appeared to him a decided advantage in connection with this cloth.

Mr. Betley said this was supposing the brattice would not be displaced by the explosion.—*Mining Journal.*

GLASS OF THE ANCIENTS.

M. E. Pelegot is of the opinion that the common glass and the plumbiferous crystal had formerly a composition which differed strikingly from that of corresponding modern products. Modern glass contains lime along with the alkali and silica. In ancient specimens lime is only found in a much smaller proportion. The crystal glass of antiquity was a silicate of lead without alkali.

WE lately illustrated Prof. Bell's electrical telephone for sending the sounds of the voice over the telegraphic wire. It is stated that he has lately made further experiments, by which he can transmit audible messages without using a battery, simply by means of the telephones and wire.

PRESERVATION OF MEAT.

THE requirements of modern civilization, such as the insufficiency of domestic food supplies to meet the demands of overcrowded populations; the massing of enormous bodies of men for military and other purposes; the enormously increased ocean traffic, owing to modern improvements in the facilities of transportation; the needs of exploring, scientific, and other expeditions, garrisons, and the like, have made the preservation of food—and especially of animal food—in nutritious form and for a considerable period, a subject of very great importance. A review of the more important methods in vogue for this purpose will doubtless prove of general interest.

The most important of these methods are such as depend upon the principle of excluding the air from the materials to be preserved. A plan of this nature, which is largely practised, constituting an important industry, and with very satisfactory results, consists in first cooking the meat thoroughly in water in the usual manner, then packing the meat tightly in metallic (sheet-tin) boxes, and soldering on a metallic cover. Through a small opening left in this cover, the space within the box is completely filled out with the liquor from the cooking (and which should be strongly concentrated by boiling), and the box is then soldered completely shut. To determine whether or not the filled boxes are hermetically sealed, they are placed in a bath of boiling salt water for a sufficient length of time to observe the escape of any bubbles that would indicate a leak; and this test having been satisfactory, the operation is complete. This process, it will be observed, involves not only the complete exclusion of the air, but also the cooking of the meat, by which its albuminous constituents are coagulated, and thus rendered much less liable to decompose. When properly carried out it affords excellent results, and forms the basis of an important and growing industry.

Another method founded upon the same principle—namely, the exclusion of the air—is to some extent employed, and has of late been practised with a view of rendering the abundant supplies of meat in South America and Australia available to the European markets. It consists, substantially, in packing the lean portions of the meat in its natural condition in barrels, and filling the space about the pieces with the melted fat obtained from the carcasses. The same in principle, but by no means so practical, is the process of covering the meat with a coating of paraffin, by dipping it in a bath of this material; and still less practical is the plan of preserving meat in an atmosphere of carbonic acid, which has been suggested.

Other processes for preserving meat depend upon the withdrawal of its moisture, or desiccation, and these consist either in drying it completely, or in salting.

The practice of cutting lean meat into thin strips, covering them with corn meal and exposing them to the sun until dry, was, and probably still is, in common use among our native Indians and frontiersmen, and a similar practice obtains in South America. This method is, however, not practicable on the large scale. The preservation of meat by the use of salt, which has been practised from time immemorial, depends also for its efficacy upon the desiccation or drying of the tissues, inasmuch as the salt employed for the purpose enters slowly into solution, deriving the moisture it requires for this purpose from the fluids of the flesh. The *modus operandi* is too well known to need reproduction here; it need only be added that, in the salting of meat, it is generally customary to employ, in addition to the salt, some saltpetre (and at times, also sugar), which acts partly the same purpose as the salt, and imparts to the meat an intensely red color. Meat preserved by this method, however, suffers a notable loss of its normal nutritive properties, inasmuch as the brine which gradually forms about the packed masses contains from one third to one half of the nutritive substances contained in the juices of the meat. The change in the constitution of meat by the salting process is affirmed by Liebig to be greater even than that produced by cooking, and the loss of nutritive value considerably greater; for in the cooking process the nutritious albumen is simply coagulated in the fibres, and retained, while in the salting process the albumen is extracted with the juices of the meat and enters into the brine, which has been found to contain lactic acid, phosphoric acid, magnesia, lime, kreatin, and kreatinin. It follows, therefore, that by the process of salting, the nutritive value of meat is unfavorably affected, a fact which the breaking out of scurvy among those who are compelled by circumstances to subsist for a considerable period upon salt meat, has abundantly demonstrated.

The smoking of meat with the aid of the smoke evolved from the imperfect combustion of wood, is likewise an extremely ancient practice, and is probably not yet completely understood. In this operation the warmth of the smoke, to some extent, dries the flesh, and certain antiseptic constituents of the smoke (especially creosote), penetrating into the mass, coagulate its albuminous constituents and render them insoluble—thus effecting its preservation for an indefinite period. The smoking process, it will be observed, has the advantage over that of salting, inasmuch as it does not deprive the meat of any of its constituents. The conversion, however, of certain of the soluble nutritive constituents into an insoluble condition, upon which the efficacy of the smoking process depends, decidedly lowers the digestibility of the flesh so treated—a diminution of its nutritive value which may frequently be quite as great as the direct loss by extraction which takes place in salting.

The use of vinegar for the preservation of meat is very general, especially in continental Europe. The material is very cheap, and the only precautions to be observed are that the vinegar shall be sufficiently concentrated, and that the air shall be excluded. It has, however, the same disadvantages as the salting process, namely, that it lixiviates the flesh, extracting from it its nutritive juices. To obviate this objectionable feature, it has been proposed to employ the vinegar, not in the form of liquid, but as a vapor. This may be accomplished on the large or small scale by simply laying the pieces to be treated upon a suitable shelf, or platform, in a closed space, above a quantity of vinegar. This space above the liquid becomes speedily saturated with the acetic vapors, which, after awhile, without the aid of heat, thoroughly penetrates into the fibres of the meat. This process has the advantage over those before named, that it does not unfavorably affect the digestibility of the meat, while imparting to it a piquant flavor, to most persons very agreeable. Its preservative power is, however, not so permanent as that of the methods before described, and is only adapted for domestic uses.

The use of the vapors of burning sulphur (sulphurous acid gas) has been suggested and, it is said, successfully practised for this purpose in France; the process consisting in exposing the meat to the sulphurous vapors for a brief period ($\frac{1}{4}$ to $\frac{1}{2}$ hour) then removing and coating it with a substance like paraffin, which shall effectually exclude the air. This process, as well as numbers of others which may be found in the official gazettes of the several patent offices, are attended with too much trouble to ever become practical on the commercial scale.

The injection of the freshly slaughtered carcasses of animals with preservative compounds, through one of the principal blood vessels has been suggested, and has formed the subject of several interesting experiments, but has thus far borne no practical fruits. Dr. Morgan, for example, recommends the injection into one of the principal vessels, after the blood has entirely flowed out, of a liquid containing saltpetre, nitrate and phosphate of soda, and common salt. He affirms (see *Illustrirte Gewerbe Ztg.*, 1865) that he has preserved a piece of beef, in apparently normal condition, and at atmospheric temperature, for the period of seven months. It seems curious, if this had really been the case, why the process had not attracted more attention, though the difficulties in the way of its operation (unless thoroughly done it is doubtless quite useless) may account for the fact.

Finally, it may be added, without entering into the details of innumerable patented modifications of the processes above detailed, that the best preserver of meat, by all odds, is cold. The preservative action of a low temperature is perfect, not only as regards the preservation of the normal character and nutritive value of the meat, but also as regards time—as witness the well-known case of the finding of the fresh carcass of the long extinct mammoth in the frozen banks of the Lena, where it had remained locked in the ice for an indefinite period. This method is, as might naturally be expected, universally practised by the inhabitants of cold climates, and is rapidly growing in importance in this country and in Europe, the necessary conditions being brought about by the use of ice. The shipment of meat from one quarter of the world to another by this means has resolved itself into a simple question of the cost of the ice required for the journey; and its shipment in this manner, from America to Europe, thanks to the rapidity of ocean transit, promises to become in the near future an industry of great importance.—*Polytechnic Review.*

CALIFORNIA PISCICULTURE.

THE past year has shown quite an increase in the catch of some of the varieties of fish of California. The increase in salmon has been most marked, and shows already that by artificial hatching the supply of this fish can be almost indefinitely increased. Observations during the past year have proven that this fish is to be found in California every month in the year, which is not the case elsewhere. The Fish Commissioners of this State have, so far as the means at their disposal would admit, acted with energy and good judgment.

The law making a close season between August 1st and November 1st has been well enforced, and with the result that further prosecution for violations will probably not be necessary in the future. In the carrying out of the programme of the law, the Commissioners have been materially aided by the railroad and transportation companies, who forbade their agents and employees to transport salmon out of season.

SUCCESSFUL PROPAGATION OF SHAD.

The closed season for shad will expire in December, 1877. At that time it is believed by the Fish Commissioners that the natural increase of the fish will be so great as to prevent their extinction on this coast. As experiments have shown that young shad cannot be kept in safety for a longer time than seven days, Prof. Baird, of the United States Fish Commission, will make no attempts to send them from the Atlantic Coast to Oregon. He intends, if possible, to send a full carload of young shad—about 3,000,000—during the coming season, which will be placed in the Sacramento River. With this additional number, it is thought the entire Pacific Coast, from San Diego northward, will be amply stocked, as from the young shad heretofore placed in the Sacramento River, adult fish have been taken at various points, from Wilmington to the Columbia River. Although the taking of shad is at present not lawful, yet numbers have been caught in nets set for other fish at various points in this State. The latest instance known to the Fish Commissioners was the taking of two adult shad in Sonoma creek last week. These fish were almost ready to spawn, and their ripe condition so early in the season shows that they can be taken here about the same time as in Alabama and Florida. During the past year the Fish Commissioners of California have placed 126,000 young shad in good condition into the Sacramento River near Tehama.

STOCKING THE RIVERS WITH SALMON.

During the past year the Fish Commissioners have had hatched out and placed in the Upper Sacramento, Pitt and McCloud Rivers 2,500,000 young salmon, care having been taken to distribute them in the smaller tributary streams, so as to protect these young fish from trout and other enemies. The Commissioners expect to hatch out and put into the Sacramento and other interior rivers a similar number next year, and will continue to do so annually as long as the Legislature of California will make suitable appropriations for the purpose. From investigations made by them, the Commissioners are satisfied that the artificial hatching and introduction of the above number of young salmon yearly into the Sacramento River, in addition to the increase from natural sources, will be ample to keep up and even increase the supply of salmon beyond the consumption of our people. They believe that the business of canning salmon for export, as now practised on the Columbia River, can, in such case, be made profitable in California. The value of salmon canned the past year on the Columbia River is estimated at about \$4,000,000, the supply being inadequate to the demand. The article of canned salmon is finding increased sale wherever introduced, and there seems practically to be almost no limit to the demands in the future. The proprietors of the canneries have already made contracts in advance for nearly 200,000 cases of the next season's catch. The limit of the supply of salmon in the Columbia River is said to have been reached, and unless artificial hatching is engaged in, that river will become as unproductive as was the case in California rivers a few years since. Some of the parties engaged in canning salmon on the Columbia River are in favor of the State of Oregon and the United States taking some joint action in preserving and restocking that stream. They state they will assist in defraying the expense attending artificial hatching of salmon, and that a sum of \$5,000 to \$10,000 expended yearly would be ample to keep up the present supply of fish in that river. The Fish Commissioners of this State report that the 200,000 young salmon placed in the Truckee and Little Truckee Rivers, Donner Lake, and Prosser Creek have done well, the young fish having lately been seen in those waters in great numbers. Should these fish survive the perils of poison from sawdust and almost impassable dams on the Truckee River, they will find their way to Pyramid Lake, and thence annually return to stock the waters from whence they came. The water of Pyramid Lake is said to be somewhat salt, and abounds with suitable food for salmon. During the past year the Fish Commissioners have made arrangements to exchange salmon eggs for desirable fish, natives of Japan and Hawaii. To the latter they sent 30,000 eggs, a portion of which are reported to have hatched out and doing well. From Honolulu a quantity of young fish were shipped to this port, but from lack of care died while on the voyage. These fish—the arva—are said to attain the weight of 15 pounds, resembling the salmon in looks, but tasting more like a shad, without, however, that fish's abundance of small bones. The arrangements for an exchange with Japan were made so late in the year that salmon eggs could not be sent this season. The Commissioners sent, however, by the steamer which sailed on the 3d inst., 30,000 white fish eggs, a portion of a supply just received from Michigan. They will also send some eastern trout eggs when received, and some eggs of the Sacramento River trout, in March next. In return the Commissioners expect to receive some mullet and carp, both being of fine eating quality. Other varieties of fish are also promised from Japan.

IMPORTATION OF WHITE FISH EGGS.

The Commissioners have just received a shipment of 300,000 white fish eggs in good order, from Michigan. One half this number were sent to New Zealand by the last steamer, under arrangements made by Prof. Baird, United States Fish Commissioner. Another lot of 300,000 white fish eggs is expected to arrive here in a few days, to be divided as above. Those retained by the Commissioners are to be hatched out at Berkeley, and afterwards to be distributed in waters of Tahoe and Donner Lakes, and Eagle Lake, in Lassen County. The white fish placed some years since in Tulare Lake are reported to have done well, large quantities of the fish having been seen during the past year. Of those placed in Clear Lake very little is known, as very few only have been seen. As the waters of this lake are very deep, the Commissioners think the probabilities are that the fish are not likely to be taken there without systematic fishing, as is practised in Lake Michigan, etc., which so far has not been tried in California waters.

EXPERIMENTS WITH EASTERN TROUT.

The Commissioners expect to receive, about the 10th inst., 200,000 eastern trout eggs, which are to be hatched out and placed in the public waters of this State. When hatched out, notice will be given to the public through the press, so that parties who may desire to stock waters can make application and procure the young fish from the hatching house at Berkeley. The eastern trout eggs heretofore received have been hatched out and placed in mountain streams; among others the South Yuba, north ford of the American and Prosser Creek, also in Calaveras Creek and other streams in Alameda, Napa, and Yolo Counties. These fish have grown and thrived well, a large number having spawned, thus insuring a continuous supply.

DOLLY VARDEN TROUT.

The Commissioners the past year made arrangements to secure a supply of the Dolly Varden trout eggs, under the direction of Myron Green, of the United States Fish Commission. McCloud River men were sent to the head waters of that stream, but failed to obtain any eggs, the fish spawning in September and October, instead of February, as is the case with the Sacramento trout. This difference in spawning time, however, assures the prevention of hybrids, no other trout being then ripe with milt or eggs. Efforts will be made the next season to procure a supply of eggs, with the view of distributing in other waters in the State which are supplied by melting snows, the only places where the fish will thrive. These fish were supposed to be only native to the McCloud River, but it is now known that they are to be found in almost all the snow-fed rivers of the Alaskan coast emptying near Behring Straits. The name of this fish in pisciculture is *Salmo Campbellii.*

CALIFORNIA TROUT.

With the view of restocking some of the streams that have been exhausted of their natural supply of fish, the Commissioners have made arrangements to procure a quantity of eggs of the ordinary trout of this State. An arrangement has been made with Myron Green, Lower Soda Springs, Siskiyou County, by which that gentleman will collect and artificially hatch out a large quantity of trout eggs. A portion of these will be purchased by the Commissioners in March. This trout, which is called *Salmo iridea*, is highly thought of in the Atlantic States, where they are considered a shyer and gamer fish than the native trout.

GRAYLINGS AND OTHER SPECIES.

This fish, said to be the most beautiful in American waters, will be propagated in California the coming season, the Commissioners having arranged to receive 50,000 eggs from Michigan. These, when hatched out, will be placed in some of the highest and coldest streams of the Sierras, and in time their produce will be used to stock all streams in the State which may be of suitable clearness and temperature. Of the other fish introduced into California by the Commissioners, the majority seem to have done well. The Schuylkill catfish, which were placed in the slough near Sutterville, have largely increased, and have been well distributed throughout the State. The Mississippi catfish placed in the San Joaquin River have also done well, a number weighing from three to five pounds having been taken at various times.

The black bass in Napa and Alameda Creeks have largely increased in numbers, and from these creeks it is expected to stock other waters of the State.

In 1873, the Commissioners placed in San Antonio Creek a number of tautog or blackfish, the only saltwater variety that arrived then in good order. These fish were strong and lively, but from the time they were placed in the creek have not been heard from. They should have increased and have been found in rocky waters. The Commissioners will this season make further attempts to introduce lobsters on this coast. With this view, Livingston Stone, United States Fish Commissioner, has been making a series of experiments to keep lobsters alive for a sufficient period of time to reach California. A full carload of lobsters and saltwater fish will be brought to this State during the coming season.—*San Francisco Bulletin.*

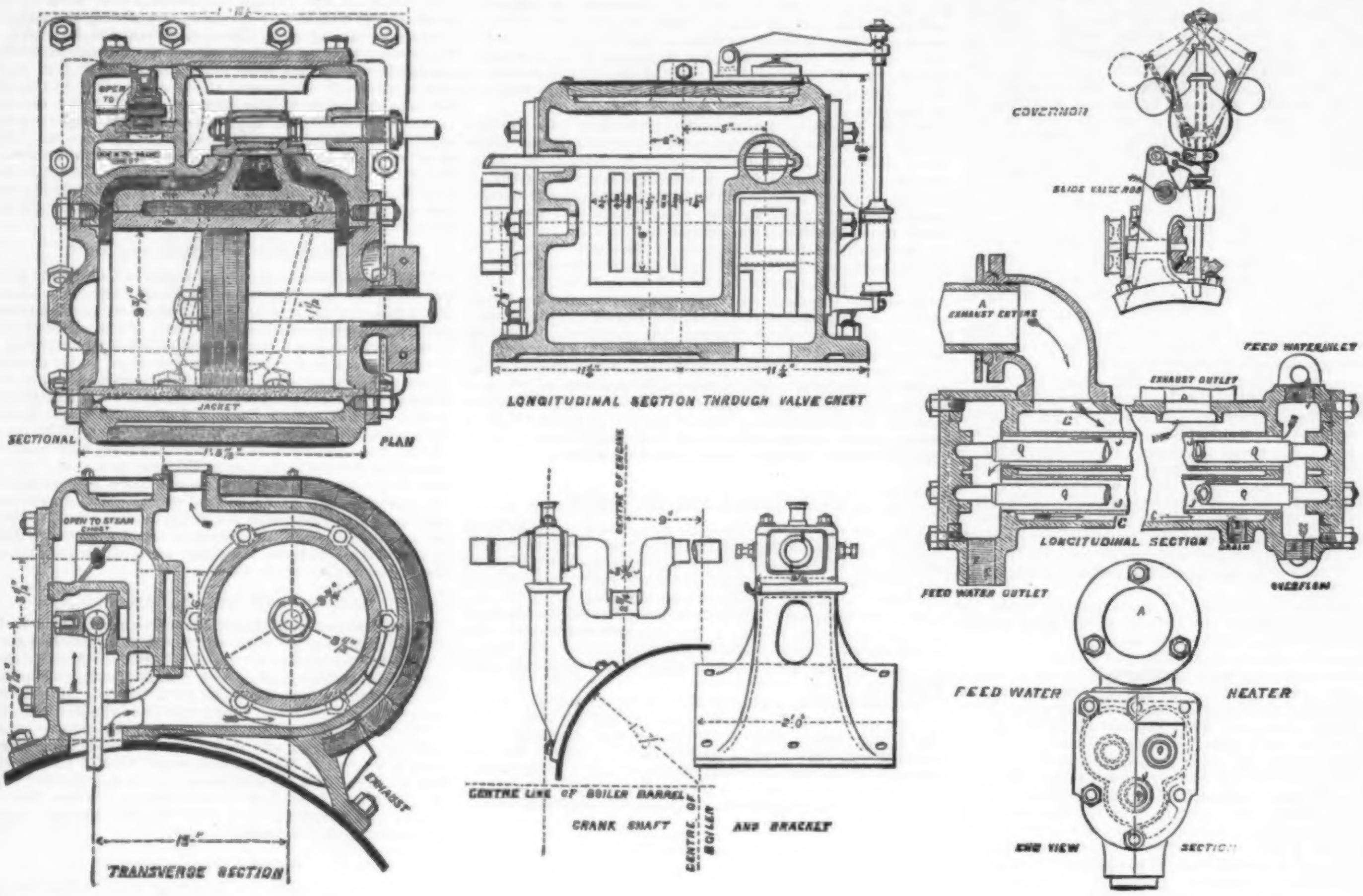
EIGHT-HORSE POWER PORTABLE ENGINE.

WITH a view to inform our readers as to the progress that is being made in England in respect to portable engine construction, we herewith reproduce, from the *Engineer*, the details of an eight-horse power machine of this kind, lately made by Wallis & Steevens, of Basingstoke.

The engine is one of a standard series, recently designed by the firm, which may be said to embody their old design thoroughly remodeled, most of the castings being made from new patterns. The engine has a jacketed cylinder, a feed-water heater, and a high-speed governor.

The dimensions of the engine are as follows:

	Ft.	In.
Diameter of cylinder	0	9¾
Length of stroke	1	0
Diameter of steam pipe	0	2¼
" exhaust pipe	0	2¾
" piston rod	0	1⅝
Depth of piston	0	2¾
Diameter of slide valve rod	0	0⅞
Stroke of slide valve	0	2⅝
Size of steam ports, ⅞in. by 6in. long	—	
" exhaust port, 1½in. by 6in. long	—	
Diameter of throttle valve spindle	0	0¾
" crank shaft	0	3
" " pin	0	2¾
Length of crank journal	0	5½
" " pin	0	3¾
Diameter of pump plunger	0	2
Stroke of pump	0	2¾
Safety valves, diameter of each	0	2
Diameter of fly-wheel	5	0
Width of fly-wheel	0	6
Speed of governors, 175 revolutions per min.	—	
Speed of engine, 125 " "	—	



EIGHT HORSE POWER PORTABLE ENGINE. BY WALLIS & STEEVENS.

The dimensions of the boiler are as follows:

Width of outside fire-box	3	2¼
Length	2	10
Height	4	4½
Barrel, 2ft. 8½in. diameter by 6ft. 1in. long		—
Twenty-eight tubes, 6ft. 7in. long by 2¼ external diameter		—
Grate area, 5·9 square feet		—
		Sq. ft.
Fire-box heating surface		37·8
Tubes		127·6
Total		165·4

The cylinder, which is completely encircled by a steam jacket, as well as lagged, is cast with the steam chest. The foot is carried all round the base, which permits it to be bolted down to the boiler-barrel in a very substantial fashion. The jacket is open to the boiler at all times, and in no way affected by the stop valve It is therefore gradually heated as the steam is raised, and always hot, ready for work; care has been taken to so construct the jacket that the accumulation of water or air in it is impossible. Judging by long observation, we believe that half the jackets that are in use are not steam jackets at all, but very often contain water only, the drainage in many cases being either entirely neglected or imperfectly carried out.

The cylinder jacket and liner are separate castings, the former bored, and the latter turned to gauges having the exact allowance made for shrinkage; the jacket is slightly heated, which causes it to expand sufficiently to insert the liner, and when cooled down with the liner in position, a perfect joint is made between the two; this plan of making steam-jacketed cylinders is now being generally adopted. Messrs. Wallis & Steevens were the first, we believe, to use it extensively with cast iron bushes for portable engines; steel bushes have been used for racing engines. This mode of forming steam-jacketed cylinders has several advantages over those cast entire. (1) Minimum risk from defective castings, as all the walls or partitions can be examined before the bush is put in. (2) There are no jacket ports to be stopped up. (3) The liner can be cast in "stiff" or hard metal, so as to be very durable, and the jacket in softer metal easily shaped and turned. (4) The liner can be made of a medium and equal thickness all round, so that the heat can be freely transmitted from the steam in the jacket to the steam in the cylinder. Some makers whose cylinders are cast entire, to insure having sound castings make the walls of their cylinders very thick, which seriously interferes with the efficiency of the jacket. (5) Reduced cost for molding and core making, the cylinder being very simple. (6) One pattern of cylinder may be used for two-sized engines by having the liners made to suit the different sized pistons. Access can be had to the slides, stop, and throttle valves, by taking off the steam chest cover. It will be seen from the sections of the cylinder that a sliding stop valve is used, with the rod placed as close to the sliding face as possible, to prevent tilting. The back of the stop valve forms a spring box, in which a piston and spiral spring are inserted, the former sliding on a planed projection on the inside of the steam chest cover. The safety valve is placed on the top of the cylinder, in communication with the jacket; the spring balance being brought sufficiently clear of the cylinder to allow the back cylinder cover to be taken off when the steam is up.

High-speed governors of the cross-armed weighted type are used, very sensitive, and direct-acting; the stand forms a guide for the slide valve rod. A cast iron tray is fixed to the bottom guide bars, for catching the oil from the bars, blocks, the small end of connecting rod, and the drippings from the piston gland, which tray can easily be emptied when necessary by simply taking out a brass plug in the bottom.

The engine is fitted with the now well-known annular space feed-water heater. The exhaust steam after leaving the cylinder enters the chamber G through the pipe A, and after traversing it from end to end, passes out again through the outlet C into the chimney as usual. The water condensed from the exhaust steam flows out at E. The heater is slightly inclined towards this end, so as to cause the condensed water to run freely away. The feed-water is delivered by the pump through the inlet B, and passes along the tubes J J, and out through the pipe F, and enters the boiler through a check valve. The pump is always kept full on, and any excess of water delivered by it not required for supplying the boiler is allowed to flow through the pipe D into the feed tub, this pipe being fitted with a regulating cock. The tubes J J, through which the feed-water passes, are traversed by rods Q Q, these rods being kept in a central position in the tubes by the ends entering sockets formed in the end covers of the heater. By the insertion of these rods the water is caused to flow through narrow, annular spaces, in direct contact with the heating surface, while by the removal of these rods the interior of the tube is left clear for cleaning. By experiment it has been found that this heater will deliver the water into the boiler, with the pump full on, at a temperature of 200 deg. to 205 deg. Fah. The heater is firmly bolted to the smoke-box at the pump end, and simply supported on a bracket at the cylinder end, to allow for the expansion of the boiler. The exhaust and feed-water pipes are fitted with expansion joints. The crank shaft brackets are hollow castings, as shown in the engraving, of massive design, without being in reality heavy; they have oil-catchers cast round them, just under the bearings. The means devised for emptying the oil out of these troughs is shown on the drawing; a tunnel is cored through the bracket level with the bottom of the trough, in the centre of which is a ⅜in. hole fitted with a plug, out of sight in the panel of the bracket, by drawing which the oil may be run into a tin. The front of the boiler is provided with the usual fittings, except the boiler cocks, which are abandoned, two water gauges being used, having between them a brass plate pointing to the mean water level.

CLYDE SHIPBUILDING AND MARINE ENGINEERING—1876.

THE year 1876 was one of much anxiety in connection with the two great industries—shipbuilding and marine engineering—which have in the lapse of years come to be so intimately and remarkably identified with the river Clyde. In many respects there was room for that anxiety, but the results of the year's work have abundantly shown that the cradle of steam navigation is still the headquarters of the shipbuilding industry. The past year began with about 140 vessels of all kinds in hand, or an aggregate of about 132,000 tons, which was a very much smaller amount of work than any one of the five years immediately preceding commenced with, while the year 1872 began with fully 268,000 tons of shipping in hand, and the year preceding, with about 308,000 tons. It is satisfactory to know, however, that in only four instances has the annual turnout of work on the Clyde exceeded that of the past year.

There were also 16 paddle steamers of a total of 10,770 tons, as against 14 of 19,000 tons, 10 of 11,400 tons, and 13 of 5,650 tons, in the years 1873, 1874 and 1875 respectively. Two of the most notable of the paddle steamers built last year were the Kiang Kwang and Kiang Yung, each of 2,500 tons, and 250 horse power nominal. They were built by Messrs. A. and J. Inglis for river service in China, and were preceded by six others, which were built by the same firm and fitted with beam engines on the American system. These vessels have been eminently successful, and, indeed, they are the only vessels built in this country which have been able to compete with those sent out to the Yang-tze by the American shipbuilders. They are generally of about 3,000 tons gross measurement, and in them the American type has been closely followed, with the exception that the hull and engine framing are of iron instead of wood. Several of the paddle steamers built last year were for passenger service on the Clyde and around the coast.

Since the year 1873, that in which coals were at such extraordinary prices, the number of screw steamers built on the Clyde has fallen off very considerably. In that year the number was 125 of a total of 218,000 tons, as against 120 of a total of 178,000 tons in 1874, 113 vessels of an aggregate of 107,510 tons in 1875, and 83 vessels of 73,840 tons last year. This remarkable falling off is sufficient to excite much thought in the minds of those persons who like to exercise themselves in connecting cause and effect. Amongst the iron screw steamers, apart from the two armorclad war vessels already alluded to, there were very few of any considerable size. The largest was the Nepaul, a Peninsular and Oriental liner of 3,600 tons and 600 horse power nominal, built and engined by Messrs. Stephens & Sons. Two screw steamers of 3,200 tons each, and named the City of London and City of Edinburgh, were built by Messrs. George Smith & Sons, "City" Line of Glasgow, Liverpool and Calcutta traders, by Messrs. Connell & Co., and each supplied with engines of 450 horse power nominal by Messrs. John and James Thomson, who devote themselves to engine work only, while several firms confine their attention exclusively to the business of shipbuilding. Messrs. Donald, Currie & Co., of Leith and London, who started a line of screw steamers between London and the Cape three years ago, had another built on the Clyde last year. She was the Balmoral Castle, 2,850 tons and 450 horse power, and was built and engined by Messrs. Napier & Sons. A new vessel, called the Alsatia, of 2,800 tons and 330 horse power, was added to the "Anchor" Line last year, the builders and engineers being Messrs. D. & W. Henderson & Co. Various other companies added to their fleets one or two screw steamers, ranging in size from 2,500 tons down to 1,000 tons; but with the exceptions already mentioned, none of the great fleets of ocean steamers received any additions.

Steam dredging plant was built in considerable quantity during the past year. Messrs. Elder & Co. built four steam hopper barges each of 400 tons with engines of 60 horse power for the Bombay Port Trust; Messrs. Lobnitz, Coulborn & Co., built and engined three of large size for Suez Canal improvements; several were also built and engined by Messrs. Wingate & Co., including two for the River Weaver Navigation Trust; and Messrs. Simons & Co. completed three large hopper dredgers—one of 350 tons and 80 horse power for the English Channel ports; one of 1,200 tons and 165 horse power, for Port Adelaide, South Australia; and one of still larger size and power for the Greenock Harbor Trustees.

Another prominent feature in the past year's returns is the large proportion of towing steamers compared with the number of such vessels built on the Clyde in any former year. Several tug steamers of great power were built on the Clyde last year, and sent to England and other parts of the world; and several were likewise built for the Clyde, which is a very unusual circumstance, inasmuch as the rule hitherto has been to depend exclusively upon the Tyne for such craft. But the Clyde towing companies are now finding out the fact that Tyne-built tugs, while they have some good qualifications, are most voracious consumers of fuel, and are consequently very expensive to maintain. Hence they are stimulating builders on the Clyde to devote their attention to the construction of tugs that will be alike powerful, thoroughly efficient, and economical in actual service. There is room to believe that a step in the right direction has been taken upon the Clyde in the construction of tugs to be worked by means of screw propellers rather than by paddle wheels, and in designing economical engines to actuate them. The latest effort in that direction is seen in the engines patented by Messrs. Rankin & Blackmore, and fitted into the screw tug Otter, lately built by Messrs. Duncan & Co. for a Port Glasgow firm. Much interest is felt in the success of that effort in practical work.

It may now be worth while to notice briefly what is being done by marine engineers in the way of improving the mechanism by which steamships are driven, with the view of effecting the utmost amount of economy that is possible. Messrs. Elder & Co. are doing their best to introduce into use their three-cylinder engines in their most improved form. Mr. James Weir's feed heater is doing remarkable things in the way of economizing fuel, and is getting into very extensive use; and the same may be said of Buckley's patent compensating piston, while it is but proper to say that the extensive adoption upon the Clyde within the last twelvemonth is largely due to the persistence with which the London and Glasgow Shipbuilding and Engineering Company, and Messrs. Lees, Anderson & Co. have employed it in the marine engines built by them. It is, undoubtedly, a most efficient and economical aid in marine engine practice.

In respect of iron sailing vessels the amount of work done last year comes to be of considerable interest when studied in conjunction with the returns for a few years preceding 1876. While in the year 1870 there were launched 40 iron sailing vessels of a total of 30,030 tons, there were launched in the following year only nine such vessels and only about one-third of that amount of tonnage. On the other hand there was a slightly sensible increase in the year 1872, a still greater increase in 1873, which was again followed by an enormous increase in the years 1874 and 1875, from 12 vessels of 19,000 tons to 53 vessels of 68,500 tons, and 90 vessels of 102,136 tons respectively. During the year just closed, however, there was no very material change in respect of the iron sailing vessels launched, and such change as did arise was one indicating a falling off in this kind of work. There were 97 such vessels launched of a total of 96,810 tons, or rather more than 5,000 tons over the amount of iron sailing tonnage launched in the year immediately preceding. Those returns also show a falling off in the average size of such vessels, which was nearly 999 tons, as against 1,133 tons in 1875, 1,292 tons in 1874, 1,583 tons in 1873, 1,136 tons in 1872, and 1,146 tons in 1871.

The iron sailing vessels of large size launched last year were certainly pretty numerous, and many of them were built for trade with the Australian and other colonies. It was not at all uncommon for vessels of this kind to be built last year up to 1,200 tons, 1,500 tons, or even 1,700 tons; still, it should be mentioned that in some former years iron sailing vessels of very much larger tonnage were built on the Clyde, even up to the 2,100 and 2,800 tons builder's measurement.

Probably the most novel feature in connection with the art of building ships that has come under notice on the Clyde during the last year or so, is that of employing four masts upon large sailing vessels instead of three, as a means towards lessening the risk of dismasting at sea, as also for convenience of working such ships. This improvement was first introduced by Messrs. Barclay, Curle & Co., into the County of Peebles, a large sailing ship which they built for a Glasgow firm in the year 1875. For the same firm they have since built two duplicates of that vessel. The system referred to bids fair to become popular upon the Clyde. In order to lessen the difficulty of setting up ships' rigging at sea, the same well known shipbuilders have, within the last year or so, dispensed with dead-eyes and lanyards, and they now adopt double screws for that purpose.—*Engineering.*

INDEPENDENT CAR WHEELS.

IT has been considered very desirable that some efficient means should be found of making one of the wheels on a car axle run loose, as the tractive force on curves will then be sensibly diminished, while the wear on wheels and rails will be very much less. According to the *National Car Builder*, the testimony of Mr. R. W. Fowler, Jr., General Manager of the Philadelphia West End Passenger Railway Co., who had special charge of the narrow-gauge railway at the Centennial Exhibition, is very satisfactory as to the working of the Miltimore wheel and axle. He reports that seven of the thirty-six cars on this road were equipped with this wheel and axle, doing their full share in transporting over four millions of passengers. The gauge of the track was three feet, length three and one-half miles, almost entirely curves, some of 250 ft. radius on grades of 155 ft, to the mile. Six loaded cars with these wheels and axles were drawn with twenty-five pounds less steam than five cars with rigid axles, although each truck of the former cars weighed 3,000 pounds more than those under the latter. The tread and flange of a Miltimore wheel, to which the Westinghouse air-brake was applied in making 160 stops daily, show no perceptible wear, while a rigid wheel shows much abrasion. Journal brasses and brake shoes were renewed twice, in some cases, with the rigid wheels, but not even once with the Miltimore wheels, nor were there any hot boxes. There were no renewals; the journals were lubricated but twice in six months. Black oil was used a portion of the time, and then Albany grease. Mr. Fowler is of the opinion that the life of car wheels so mounted must be doubled with a corresponding saving of wear on the rails, and with but slight difference between the life of rails on curves and on straight tracks. We take these facts in substance from the *National Car-Builder.*

THE SUTRO TUNNEL.

THE Sutro tunnel, though it is designed for private rather than public uses, will rank among the great engineering works not only of this, but of any age. The tunnel was designed to afford a horizontal outlet for the immense deposits of silver ore in what is known as the Comstock lode under Virginia City, in Nevada. These deposits are 2,000 feet below the surface of the hills under which they lie. At a rough estimate 3,000 tons of waste rock are lifted 2,000 feet daily, and the water has to be pumped into a system of cisterns 200 feet apart, at enormous labor and expense. The tunnel was projected by Adolf Sutro, a German engineer, and begins in the Carson valley, four miles east of the lode, which it is intended to pierce at a depth of 2,000 feet. It has now been driven over 15,000 feet into the mountain, and is progressing at the rate of about eighty feet per week. Four perpendicular shafts were started at equal distances along the route from the surface, to meet the main tunnel. The workings from the first shaft and the entrance met about three years ago. The second shaft encountered a body of water, which burst out so suddenly that the workmen were obliged to flee for their lives, and the shaft became a well. The main tunnel reached this shaft in 1875, and drained the water. The third shaft was also drowned out, and the fourth has not reached the level of the tunnel. The headway which is made is unexampled in the history of engineering, owing partly to the firm nature of the rock, and the question of its completion is only a matter of a short time. A ganglion of tunnels will follow the veins in all directions and the water will drain itself into the Carson River, while the ore and waste rock will be easily run out on the horizontal railroad.—*National Car-Builder.*

NEW BRIDGES AT OR NEAR NEW YORK.

THE North River is soon to be spanned at St. Anthony's Nose, not far from Peekskill, by a railway bridge. The design is to carry a double track railway across the river, so as to afford direct railway communication with the Eastern States, by a single magnificent span of 1,680 feet in extent. The following are the dimensions of the work proposed: Entire length of the bridge, 2,230 feet; distance between centers of towers, 1,680 feet; clear span, 1,680 feet; clear height above water, 165 feet; railway grade above water, 190 feet, and height of towers above water, 340 feet. The towers are to be built of wrought iron, with granite foundation piers.

The following bridges are now in course of construction: East River bridge, 1,600 feet long; Poughkeepsie bridge, 1,030 feet; Blackwell's Island bridge, 1,270 feet; and Hudson River tunnel, 10,000 feet in length. Work has been long in contemplation on this new bridge, and the cost will be defrayed by a private corporation.

PASSENGER TRAVEL, NEW YORK CITY.

FROM the reports of the various city railway companies made to the State Engineer for 1876, it appears that the daily travel on the eight principal street railways, running parallel, north and south, is as follows:

Roads.	Cars.	Horses.	Pass. daily.
Fourth avenue	116	779	36,411
Second avenue	156	1,158	43,221
Eighth avenue	112	1,150	44,815
Belt	132	1,133	44,872
Dry Dock	126	778	46,544
Sixth avenue	100	1,178	48,859
B'dway & Seventh avenue	132	1,193	54,563
Third avenue	276	1,079	94,771

SAVELLE'S SYSTEM OF DISTILLATION.

WE illustrate herewith the large apparatus in Springer & Co.'s great spirit and yeast manufactory at Maisons Alfort, near Paris, France, which is said to be capable of utilizing daily 55,000 pounds of barley, rye, and corn, mixed in equal proportions.

In order to obtain regular working with such large quantities of material, two conditions have to be fulfilled. 1. Perfect cleanliness throughout the whole apparatus, and the avoidance of any stoppage in the inner system of tubes. 2. The complete separation of the liquids produced.

The first condition is substantially obtained by the swift passage downwards of the material subjected to distillation. Having to travel, in passing through the apparatus, 410 ft., it accomplishes the descent in six minutes. This gives a speed of 13.65 inches per second, and it is easily seen that with so rapid a movement interior stoppages are nearly impossible.

Each section of the distillation column is provided with five bronze observation tubes which allow of an examination of the interior without interruption of the working. The

Fig. 1.

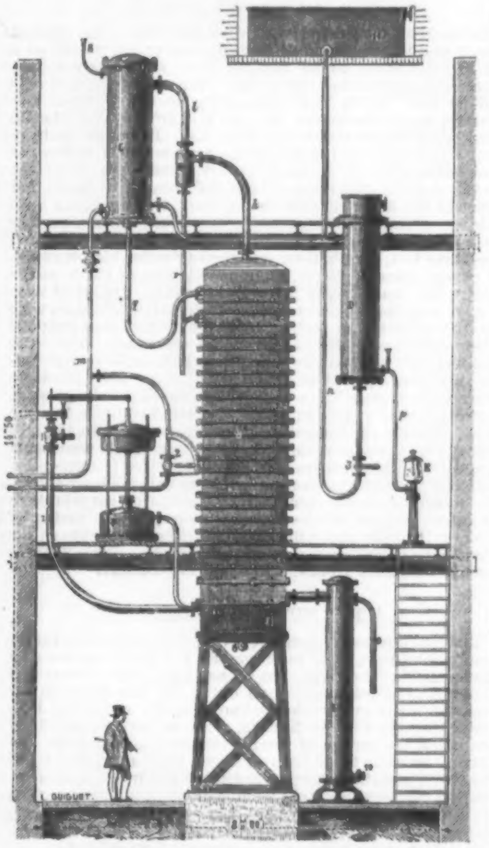
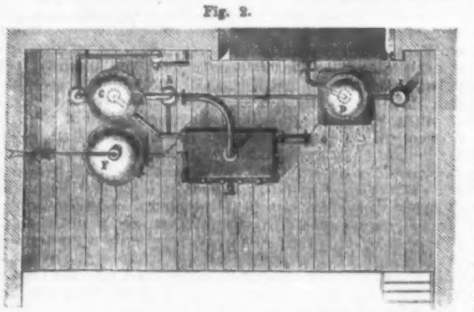


Fig. 2.



THE SAVELLE SYSTEM OF DISTILLATION.

second condition which relates to the separation of the liquid is well fulfilled. The liquid subjected to distillation, which, as above stated, forms a continuous stream 410 ft. long, is traversed in every direction by the steam which carries with it the alcohol formed. The intimate commingling of steam and liquid to be distilled causing a complete absorption by the former of the alcohol contained in the latter. Besides this, the operation of distillation is hastened by the preparatory warming apparatus, provided with large heating surfaces, which utilizes the lost heat of the mass of alcoholic steam issuing from the distillation column, and therefore saves a good deal of fuel. As there is no stoppage in the working, it is necessary that a complete separation of the alcohol should take place regularly, and that none should be lost in the residuary liquors which run out from the base of the column. This result is assured by the steam regulator which maintains constant working conditions. Everything has been arranged so that the matter to be distilled should be kept as long as possible in contact with the steam. The disposition described induces an energetic separation of the contents of the material to be distilled, facilitates the departure of the subsidiary products, gives a working season of eight consecutive months, and allows of a passage through the apparatus of 15,400,000 pounds of material, without any cleaning being needed.

The material to be distilled is first carried by the feeding pipe, *m*, into the alcohol warmer, C, which, as above stated, transmits to it the lost heat of the column below, thereby partially condensing the alcoholic vapor. After this preparation it passes by the pipe, *g*, on to the upper surface of the rectangular copper distillation column, A, which is composed of 26 rectangular sections, bound together by cast iron clamps, and supported on a framework of iron. In this column the distillation and gradual and methodic enrichment of the alcoholic vapors take place; here the material spreads in thin layers traversed in every direction by the steam brought in by the pipe, *i*, and the introduction of which is regulated by the admission valve, *t*, of the steam regulator, F. A constant temperature is maintained by this latter, and the feeding is regulated by the screw admission cock, 2. The foam breaker, B, stops and returns to the column, the substances carried over by the current of alcoholic vapor passing to the alcohol warmer. The tubular cooler, D, arranged in compartments, receives cold water from the reservoir, H, by the pipe, *u*, and communicates with the graduated gauge and discharge, E, which measures the flowing of the phlegm. The condensation which is partially accomplished in the condenser, or alcohol warmer, is finished in the cooler, D. The large cylinder, G, is used for the reception from the column, and drawing off by means of the conduct, *o*, of the residuary products, *j* is the delivery pipe of the regulator, F. *k* and *l* are tubes which carry the alcohol tubes from the distillation column to the foam breaker and alcohol warmer. *r* is the return pipe from the foam breaker to the column, and *s* the air pipe of the alcohol warmer.

The general construction of the entire apparatus is such as to secure regular working at a rigorously constant temperature. The apparatus of Messrs. Savelle, Son & Co., of Paris, is adapted for the distillation of all material yielding alcohol, and is made of various capacities. It is now working in beetroot sugar and molasses manufactories and in distilleries in France, and is soon to be applied to sugar works in the West Indian colonies, and in the great sugar works of the Viceroy of Egypt. In Spain and Italy it is used for the distillation of wine.

NEW BROMINE-STILL.

By W. ARVINE, Hartford City, W. Va.

THE object is to economize the materials used in the manufacture of bromine by saving a portion of the vitriol and manganese, or alkaline chlorate, and by dispensing with the caustic alkali heretofore employed for absorbing the vapors and gases that escape uncondensed from the worms.

S is the still proper, wherein the bromine is generated by the usual methods.

This still may be made of any of the materials commonly used for the purpose, such as stone, terra-cotta, pottery ware, or lead; but this still has a funnel-shaped bottom or floor, in the form of an inverted cone, which may be more or less broad in proportion to its depth, according to the nature of materials used.

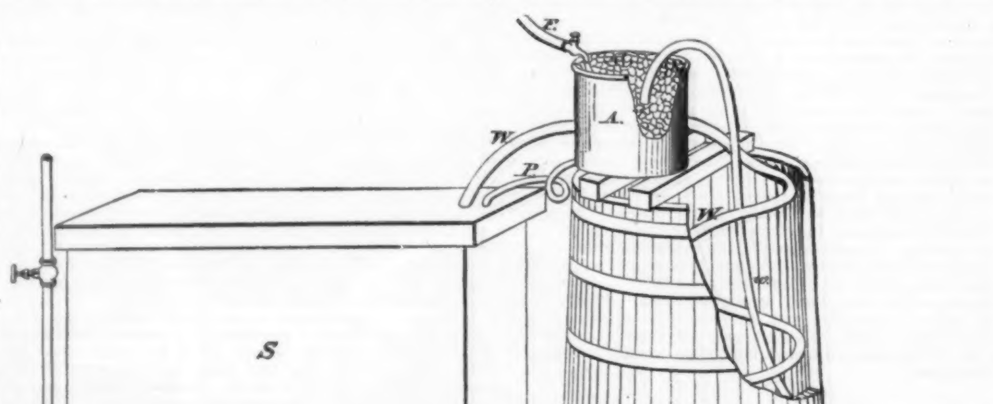
The apex of this funnel or cone is provided with two perforations—*s* for the admission of steam, and *w* for the withdrawal of the waste or exhausted materials. This still is provided with the condensing worm W, which is surrounded with hold water while in use, and the receiver, R, is also provided with a worm, *w'*, which serves for additional condensing surface, and an outlet for the uncondensed gases and vapors of chlorine, chloride of bromine, air, etc., which escape in considerable quantity from the worm and receiver. The second worm, *w'*, continues to absorber A, which is preferably a stone or earthen jar of such size in relation to the still as experience would show to be necessary. Usually about one-twentieth the capacity or size of the still will suffice for the absorber.

The jar, A, is filled with suitable material, such as coke fragments, or pieces of stone, pottery, glass, or any convenient material, which, in a dry or moist state, may present sufficient and proper surface for the condensation and absorption desired. The small pipe shown in the drawing, and terminating in the faucet, F, serves to convey bittern or other suitable liquid for absorbing the vapors and gases from the worm, *w'*, and conveying them back to the still, S, by the curved pipe, P.

By this arrangement of still, the offensive gases and vapors which usually escape into the air are entirely absorbed and saved, and the air is allowed to escape freely from the top of the absorber. As the chlorine and chloride of bromine serve to liberate bromine from its natural combinations, their complete return to the still increases the amount of bromine obtained, and lessens the amount of manganese, or alkaline chlorate, and vitriol usually required, while the conical bottom of the still is easily rinsed clean with water, or is cleansed from sediment by the rapid withdrawal of the exhausted liquors.

The steam used in heating and agitating the contents of the still is most advantageously admitted at *s*, since it will only stir up the manganese and oil of vitriol sufficiently when admitted under the charge.

It has been customary in bromine making to introduce the pipe, *w'*, into a dish containing a strong solution of caustic soda, which, when nearly saturated with chlorine, bromine, etc., was then transferred to the still, and sufficient vitriol and manganese added to liberate its bromine. In this method only a portion of the gases was absorbed, and the remainder escaped into the air, to the annoyance of the workmen and neighborhood, and to the loss of the manufacturer. In my arrangement I dispense with the use of caustic alkali, and fully overcome all the objections and disadvantages connected with its use, such as odor, chemicals used to decompose it, and loss of chlorine, while the pressure exerted upon the still by the dipping of this waste-pipe, *w'*, into the caustic solution is entirely removed by the arrangement herein described.



ARVINE'S NEW BROMINE STILL.

THE PHOENIX STEAM BREWERY, NEW YORK.

THE brewery of H. Clausen & Son may be considered, in many respects, a model brewery. A description of it may, therefore, be useful to those of our readers who may not be familiar with these leviathan establishments in the larger cities of the East and West.

The founder of this brewery was the late Mr. Henry Clausen, who to some extent may be considered one of the pioneer brewers of the country. In 1858 he opened the brewery that has now grown to such magnificent proportions, and he died about six years ago. The business is now conducted by his sons, Henry, George, and Herman.

The Phoenix steam brewery is situated in East 47th st. and 48th st.; it has a frontage of one hundred and fifty feet, and it stands upon eighteen city lots, including yards and ice-houses, and has a capacity of six hundred barrels. Their trade last year was 71,175 barrels. The firm is engaged in the brewing of both ale and lager beer, but the two brewer ies are quite distinct; Mr. George Clausen is the ale brewer, and Mr. Herman the lager beer brewer.

Commencing at the fifth floor, the topmost story of the building, is the surface cooler; the dimensions of which are 60x75.

On the floor below are the capillary coolers, two of the largest coolers generally used, one of which is placed horizontally above the other; by this arrangement about one-third in ice is saved. On this floor also is the malt mill, and scourer, two machines of very large size. The malt mill grinds about two hundred and fifty bushels per hour.

There are also two mash-tubs with a capacity of four hundred and fifty bushels each.

By an admirable arrangement the two kettles are placed underneath the mash-tubs on the floor below; these kettles have a capacity of about two hundred and fifty barrels each. By an ingenious disposition of copper pipes, which can be connected with each of the mash-tubs, any difficulty can be overcome instantly in the event of any accident to either of the kettles.

On this floor is the laboratory, a very interesting room, in which chemical tests of the most important and delicate character are made under the direction of Professor Bruns. The Messrs. Clausen are very particular in being assured of the integrity of the quality of everything they use. One of the instruments we noticed in the laboratory was a polymeter for the testing of saccharine, and another instrument for the microscopic examination of all the malt and yeast that is used.

In this laboratory is a very ingenious mechanical arrangement, denominated a Watchman's Register; this elaborate contrivance has wire communications with certain brass knobs in various parts of the building, which the watchman pulls as he passes them, and these register on a roll of marked paper, passing over a kind of drum, the hour and minute the watchman was in that part of the building, and it also registers the time of the watchman's arrival and departure from the brewery. Any failure in the register would be presumable evidence that the watchman had been absent from that designated floor or cellar.

Below this is the ton room, where the beer passes down into skimming vats, where it remains for about thirty hours for fermentation and separation. Four of these tons average two hundred and thirty barrels each.

Passing into the Forty-eighth street section of the brewery, we entered a large room, where there is a storage of about five hundred bales of hops.

On this floor, which runs clear through from block to block, are the lager beer and ale barrel washing rooms. The two are, however, quite distinct from each other.

Near by is the fermenting room for ale, in which are twelve tons, each ton averaging a capacity of ninety barrels.

Below this floor, on the ground floor of the building, in Forty-eighth street, is the racking room. Adjoining this is the storeroom for fresh ales. These are delivered from Forty-eighth street, and the storerooms for lager are on Forty-seventh street, and delivered from that street; thus

to avoid any connection between the two breweries, the deliveries are on two different streets; being, in fact, two distinct establishments.

The cellars are filled with storage vats, having a capacity of about one hundred and fifty barrels each.

In the sub-cellars there is storage for stock ales, running right through from 47th to 48th streets, for two hundred feet. These cellars are filled with storage vats, two of which hold eight hundred barrels each. There is a storage capacity in these vaults of from eight to ten thousand barrels of ales.

The ice houses are two in number, the dimensions of one being 65x75 feet, and the other 40x60 feet; their capacity is fifteen hundred tons of ice in one house, and about seven hundred tons in the other.

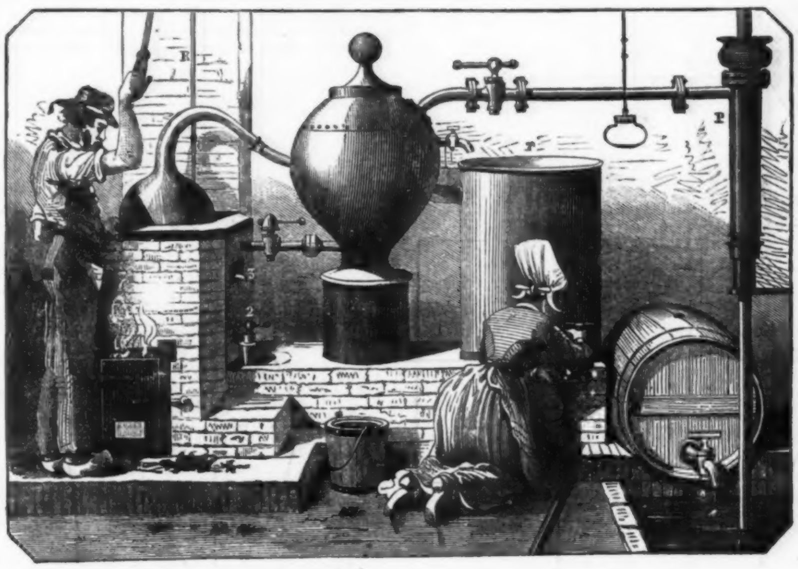
Adjoining the cellars is a keg elevator, of an ingenious construction, and almost self-acting, bringing up the filled kegs, and taking down the "empties." It will lift one thousand kegs per hour.

In the engine room there are eight pumps, namely, an air pump, a feed pump, an engine pump, and water pumps. There are also two large steam boilers.

In the cooper shop, on the opposite side of the street, twelve men are constantly engaged making and repairing kegs and barrels.

The suite of offices of the brewery are very complete, and present a business-like appearance, that at once impresses the visitor on his entrance that he is in the very atmosphere of mercantile affairs. The private office of the firm, at the back of the counting rooms, is a very cozy apartment, admirably adapted for a confidential business talk.

The stables, adjoining the cooper shops, are generally occupied by about fifty horses. The wagon room has accommodation for the twenty-five wagons used daily by the brewery.—*Brewers' Journal.*



COGNAC DISTILLATION BY FRENCH PEASANTS.

FRENCH COGNAC DISTILLATION.

THE distillation of Cognac brandy is not a manufacturing operation carried on on a large scale, but it is a home employment, prolonged during the entire winter among the rustic vine-growers of France.

The distillation apparatus is placed in a cellar, or in an apartment on the ground floor. At the rear of the room the boiler is fitted in masonry. It is surmounted by a head, the neck of which adapts itself to the wine-heater, and terminates in a pipe which passes through the vessel where the wine to be distilled undergoes a first warming by the lost heat.

This pipe reaches the worm, the spirals of which are surrounded with solid water, and in which the condensation of the alcoholic liquid takes place. When the boiler is exhausted, a tap is opened to allow the wine to pass out, and another is opened to fill the boiler with the wine contained in the wine-heater. A pump adapted to a recipient of stone feeds the wine-heater.

These brandies are not fit to drink until they indicate but 50° or 52° by the centesimal alcoholometer. If brandies are immediately distilled at that standard, as evaporation takes place through the casks, the loss would lower the standard. But the operation is carried on as follows: the wine is subjected to three successive distillations. It is then placed in a well-cleansed wine-preserver, then finally a boiler is completely filled with this wine, and distillation is effected which produces a liquid indicating 63 to 70 per cent. of alcohol.—MAURICE GIRARD in *La Nature.*

VIENNA BREAD AND COFFEE.

A NEW Vienna bakery has lately been opened in New York, at Broadway and Tenth street.

In the basement are the bakery, kitchen, coffee room, ice-cream room, store rooms, etc. The ovens in the bakery are like the old fashioned brick ovens which were used before the introduction of stoves and ranges, but on a much larger scale. There are six of these, each twelve feet long, and at the broadest part nine feet wide, the shape being oval. A roaring fire of wood is made in one of these ovens, and kept up until three feet of masonry underneath it are heated through. The ashes are then carefully swept out, and the bread is baked on the hot tiles which form the oven floor. Steam pipes pass through these ovens, but these are heated only while the baking is in progress, in order to maintain an even temperature.

It is necessary to make a new fire in an oven only once or twice in three days, according to the amount of baking required. Fifteen bakers are employed night and day, who relieve each other in gangs of five.

Although the bread here produced is of fine quality, it is said not to be equal to the article that is sold in Vienna. The latter is made from a special grade of wheat, grown in a certain locality of Austria famous for its excellent grains.

The delicious coffee, crowned with whipped cream, which was familiar to Centennial visitors, is made in the following manner: The coffee, a mixture of Java and Mocha, is ground very fine and placed upon a piston, perforated like a colander, which is covered with felt and fits tightly into a metal cylinder, large enough to hold a gallon. Boiling water is then poured upon it, and after this has remained long enough to extract all the strength of the coffee, the piston is worked upward from the bottom of the cylinder by means of a powerful screw attachment. This creates a vacuum under the piston, and the coffee liquid is instantly sucked through the perforations into the space beneath, while all the grounds remain upon the felt covering. When the bakery at the Centennial Exhibition was in operation, six thousand cups of coffee were sometimes made by this process in a single day.

SCHWARTZ'S SUGAR REFINERY, LONDON.

HEARING that Mr. John Schwartz, the sugar refiner, had taken out a patent for improvements in the manufacture of "pieces," and being bent on satisfying ourselves as to the merits of his new invention, we recently paid a visit to his refinery. It is situated, as the London refineries generally are, in the most crowded and poorest neighborhood of the East End, in the midst of Whitechapel and Spitalfields, and as one approaches it the large pile of buildings, seven stories high, with its tall chimneys towering still further above into the air, bear unmistakable evidence of the industry and enterprise which exist even in this woe-begotten portion of the great metropolis. A survey from the roof of the refinery affords an extensive view of the narrow streets and thickly packed houses all around: and, starting on our hasty tour of inspection of Mr. Schwartz's sugar-house from this elevation, we first notice a condenser in full operation, turning into water the steam as it leaves the boilers in the interior. This machine is also for the purpose of practising economy, in preventing a needless waste of water; and the saving thus effected will be thoroughly appreciated when we state that for a cost of £750 in fixing the apparatus there is a gain of £1,200, the water rate payable being about £2,500 per annum.

Descending to the top floor, we see a crane at work in bringing up from vans in the roadway beneath sundry bags of raw sugar, which, if not stored away at once, are ripped open and emptied through a grating in the flooring into an iron tank fixed on the story below, where it is well mixed with water, and, soon melting, assumes a dark and muddy appearance. Before noticing the *modus operandi* of sugar-refining any further, we may observe that the raw material in use is carefully selected from the finer descriptions that are at the moment available in the Mincing Lane market. When they can be got—which is not now, owing to their unusual scarcity—West India Muscovades are preferred; and in lieu of these, dry Date Bengal, Mauritius syrups, common Madras Jaggery (which is of better quality than formerly), useful colory and strong-grained sorts of other East India, and beet-root sugars of well-known standards of purity and excellence. The thick, dirty looking fluid we have described is now drawn off into what are termed filters—that is, long bags made of the stoutest and finest linen, costing no less than £800 a year. These are placed into separate cells, which contain altogether about 3,500 filter bags, each one engaged in the important office of extracting and discharging the pure saccharine juice from the sugar itself, and retaining in their enclosure the dirt, sediment, and other corrupt matter which is always to be found more or less in sugar that has been imported in an imperfectly or semi-refined state. It may be easily imagined that the bags themselves are so impregnated and fouled with refuse as to require a thorough washing before being used again; and to witness this necessary cleansing we descend into a lower floor, where, surrounded by a hot vapor in an almost stifling atmosphere, we discover several men naked to their waists, as if enjoying a Turkish bath, busily occupied in a grand wash, as they stand at a line of troughs wringing and rinsing these linen receptacles of departed sweets. As the bags are finished off, they are passed between tight wooden rollers, which thoroughly squeeze out what black moisture remains in them, and, making them dry at the same time, they are ready directly for the man who, sitting at the opposite end of the apartment near the window, is deeply absorbed in tying them up at their mouths, into which is fitted a tube, by which the purified syrup escapes on filtration. We now arrive at the most pleasing and interesting part of the refiner's business.

The newly made syrup as it comes from the filtering is of a clean, bright, and pellucid color, and fit to be rapidly converted into sugar of different crystallizable forms. For the more complete purification of the said syrup, it is next poured into narrow pits of powdered animal charcoal fourteen feet deep, which are arranged in rows in the floor underneath. From these pits the sparkling liquid passes out into the vacuum pans, which are, in fact, huge copper boilers, closed, and heated by steam to 140° F., where the liquor is kept in constant agitation until it gradually crystallizes into the more solid and palpable kind of grain recognized in most refined or pieces. This brings us to the final stage of the manufacture, where the sugar is let down as wanted through an aperture in the ceiling into the centrifugal machines on the ground floor, which, spinning round like tops in a capacious basin, at the rate of about seventy revolutions in a minute, force the sugar against the sides as though it were walled up; and while this violent motion is continued, a rose-shaped spray of water is thrown upon it, till the sugar is changed to the required bloom or complexion.

More of this presently, as we wish to say first a few words in reference to the prominent part which charcoal plays in the refining of sugar. In the case of which we are immediately treating, the charcoal employed was of the very best quality, produced from the burning of prime ox shank bones, such as are to be had only in the London market, which, like all leading towns and cities, draws from other places to itself the largest as well as the choicest supplies of consumable articles of every description. These bones, moreover, are always better than what are imported from South America or Australia, being entirely free from the deterioration of quality which occurs in those that have come some thousands of miles across the seas. The virtue of this charcoal is so very great, that the refiners rely on it exclusively to remove all impurities that may lurk undetected in the liquid ere it passes into sugar. The chamber containing the pits above-mentioned is where the charcoal arrives in a cool state for instant application, and after it has been worked and is brought away in a damp condition, it is deposited in a heap, where the place is so constructed that as it dries it falls through into the basement below, to be revivified by being burned in the furnace to a red heat before it is again employed. When this fiery ordeal is over it is allowed to fall between perpendicular slabs of iron, about two inches apart, which, freely admitting the air, cause the charcoal to be greatly reduced in temperature, when it is shovelled into iron barrows to be carried up to the proper floor by a lift, one load being sent thither, while another is received in exchange to undergo similar treatment.

Let us now resume. Speaking of what was done in the centrifugal machine room, we said that it was there where the finishing of the refiner's work took place. True enough; and accordingly the sugar, on being taken out of the machines, is wheeled away to a spot whence it is removed to warehouses above, to be strewn out on the cooling-floors, weighed, and delivered without delay. At a time when complaints of short weight in sugar are not unknown, our readers will, doubtless, be glad to hear that the utmost care is observed by Mr. Schwartz and his obliging manager to insure that all the sugars they supply are of full weight. Their plan is to put underneath the weights, on one side of the scales, an empty sack of equal size to those which are about to be filled, and weigh the bags singly, so as to make them as nearly as can be two hundredweights net each; and to further avoid the possibility of any mistakes that might still arise, one bag in every five is re-weighed on delivery, prior to its being slid down the tray into the carman's wagon—the last act that is performed by the honest-dealing sugar refiner. To this portion of our notice we may add that the arrangements throughout Mr. Schwartz's refinery are of the most perfect order, and that the utmost cleanliness compatible with the due execution of the work itself is perceptible in all his modes of preparation. The expeditious manner, also, in which the whole course of manufacture is gone through is none the less deserving of commendation, as raw sugar can be brought in from a river-side wharf or dock for melting, and converted into the refined product for delivery from the refinery within the short space of forty-eight hours.

What we particularly wish to draw the attention of the grocery trade to is the patent which Mr. John Schwartz has secured for the invention of "improvements in the manufacture of sugar," chief among which are the methods for "removing all such objectionable matters from raw sugars, such as coloring matter, salts, and uncrystallizable sugar," as are contained in certain proportions in the raw material, "prior to the sugar being melted in the refinery;" or, "to cleanse them so as to fit them for use for domestic or household purposes, without subjecting them to any other process of refining;" and his "plan of dealing with sugar as it leaves the vacuum pan or other evaporating pan in a concrete form before undergoing the process of drying in the centrifugal machine." To us the last appears by far the most valuable improvement, as the trade themselves will readily admit when it is more fully explained to them. In doing this it may be advisable to quote Mr. Schwartz's own words, where, in his specification, he states:—"Hitherto it has been found that, however carefully the sugar after leaving the centrifugal machine was spread out in the cooling-floors or sugar-bins, it was impossible to sufficiently cool it to prevent its loss of bloom and its becoming darker in color, which result from the packing of the sugar while hot in casks or bags. I claim for my invention the advantage of reducing the temperature of the sugar while in the centrifugal machine to that of the atmosphere, and even below it during the summer months, thus insuring its retaining its bloom and not deteriorating in value."

All grocers, whether wholesale or retail, will not be slow to perceive that in this new plan of cooling and packing unstoved sugar are two immense advantages over the old one, which affect the money value of the article in the same degree. Firstly, by a "loss of bloom" there is a corresponding deterioration of quality, which means besides a reduction in price; and secondly, there is a very probable deficiency in "weight" in consequence of the sugar being packed while it is scalding hot. Fadiness in the former and shrinkage and evaporation in the latter case are sure to follow; and when the outturn of sugar sold by a dealer a week after it was made is compared with the original sample that was shown on the morning of its sale by the refiner, no wonder that objections to it are so frequently taken, and that the retailers should so often grumble at the goods that are supplied them. Great as the improvement really is, its only difference from the old-fashioned mode consists in the very simple plan of using cold instead of warm water when the sugar is in the machines; and we are convinced that buyers of all classes will not fail to appreciate the boon that is now offered them in the shape of Schwartz's Patented Pieces.—*The Grocer.*

LESSONS IN MECHANICAL DRAWING.

By Prof. C. W. MacCord.

Second Series, No. V.

In Figs. 31 and 32 are shown two very common cases of intersecting surfaces; a sphere being penetrated by a cylinder in the former, by a cone in the latter, the axis of the penetrating surface passing through the center of the sphere in each instance.

The intersections themselves will be circles, seen edgewise in the front view (the axis being vertical), and consequently appearing there as right lines. The demonstration is almost self-evident; in Fig. 31 the sphere may be regarded as generated by the revolution of the semicircle $c\ a\ e\ d$, the cylinder by that of the rectangle $l\ m$, about the axis; a and e are common to the semicircle and the rectangle, and consequently generate circles, whose radii are $a\ b$, $e\ d$, common to the two surfaces. It may seem rather superfluous to call attention at such length to so obvious a fact; but as we have too often seen this drawn as in Fig. 33, the intersections being shown as curves, it may not really be superfluous after all. In like manner, the cone in Fig. 32 may be generated by the revolution of the triangle $x\ y\ s$ about the axis, the points u and r being common to the triangle and the semicircle which generates the sphere, the circles whose radii are $u\ v$, $r\ s$, will be common to the cone and the sphere. Extending this reasoning, we see that if any two surfaces of revolution having a common axis cut each other, the intersection will be a circle, generated by the intersection of the meridian lines. And if they are tangent to each other, they will be tangent all round the circumference of a circle generated by the point of tangency of the meridian lines. Thus a bullet in a gun-barrel, provided that the gun is a smooth bore and the ball fits it, will touch all round the equator. So an orange in a funnel will touch it all round a circle, and if we split the two through the axis, the section of the funnel will be tangent to that of the orange. In Fig. 34 we have both cases, tangency and intersection, illustrated; the straight meridian line touches the curved one at a and cuts it at b, so that the horizontal through the former is the circle of tangency, that through the latter the circle of intersection.

In Fig. 35 we have again a sphere penetrated by a cylinder, but the axis of the latter does not pass through the center of the former. For convenience, however, we place this axis, $A\ B$, in a vertical position; and another vertical line, $C\ D$, through the center of the sphere may be regarded as its axis, which in the top view appears as the point C. Now if we cut the sphere and the cylinder across by any horizontal plane, as $a\ b$, the intersection with the former will be a circle whose radius is $a'\ C$; this circle, of which a part is dotted in, is seen in that view to pierce the cylinder at d' and e', which in the front view will appear at d and e on the line $a\ b$, and repeating this process, using different planes, we may find as many points as we deem necessary. This proceeding may also be reversed; thus, to find the point on the extreme left, describe about C the circle through m', project l' to l, and draw the horizontal $l\ m$, then m will be the required point, at which, it will be observed, the curve in the front view is tangent to the left-hand element of the cylinder. In order to find the lowest point of the curve, draw $C\ E$ and produce it to n'; about C describe a circle through n', which will be, of course, tangent to the circumference of the base of the cylinder, project r' to r, draw the horizontal $r\ n$, and project n' to n, the point sought. In a precisely similar way we find the highest point, which evidently will be the one nearest the axis of the sphere, as the lowest one is the most remote of all.

In speaking of the highest and lowest points, it will, of course, be understood that we refer only to that curve of intersection which is lettered; from the nature of the case, as the cylinder passes entirely through the sphere, there will be two curves, precisely similar and equal to each other, but in reverse positions, as shown in the figure. The student may, at his option, construct the development of these curves on the cylinder, which operation we need not waste time in describing.

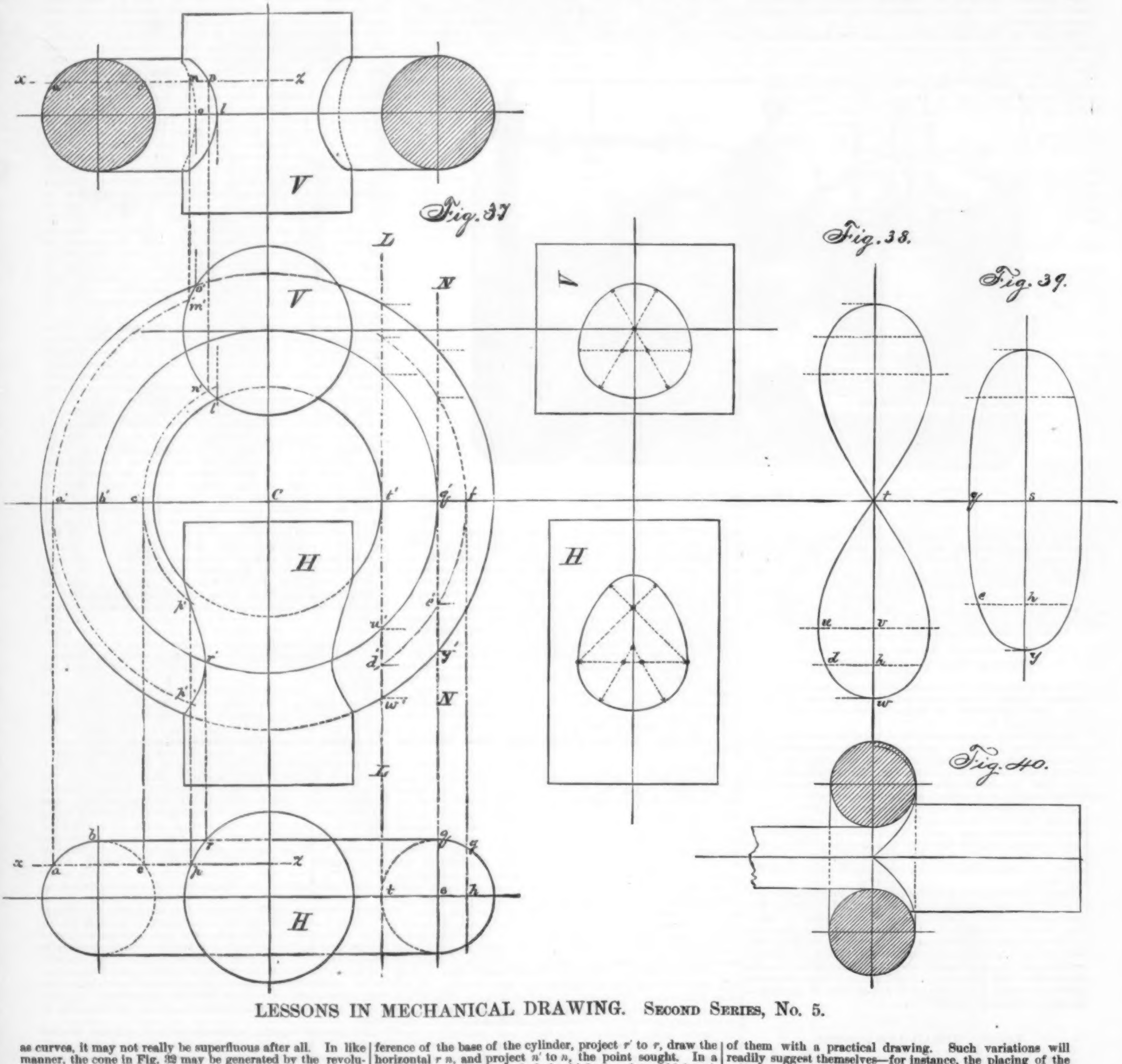
In Fig. 36 we have the sphere penetrated by an inverted cone, whose axis does not pass through its center. But the vertical axes are in this instance both in a plane parallel to the paper in the front view, so that we have at once a and b, the lowest and highest points in the upper curve, and also c and d, those in the lower.

If we draw any horizontal plane $u\ y$, it will cut the cone in a circle whose radius is $u\ v$, the sphere in another whose radius is $x\ y$, the centers in the top view being D and C respectively. These circles intersect each other at p', p', which being projected back to the line $u\ y$ give p a point in the curve—a process which may be repeated at pleasure until the intersection is determined with the desired precision.

It will be found good practice to revolve these solids into a position like that of the preceding figure; also to draw them in such a position at first, and then to construct the intersection, as well as to draw the development of the curves on the cone. In short, it is not easy to have too much practice in manipulations of this kind, although it is not essential to make finished drawings in all cases. The benefits to be derived from it arise from the exercise of the imagination, and from the adaptation of general principles to special cases, and, in order to realize these to the fullest extent, the construction of comparatively rough diagrams in pencil is all that is required.

Variations in the conditions assumed, it must not be forgotton, are very valuable, as insuring a thorough understanding of the modes of operation, without any association of them with a practical drawing. Such variations will readily suggest themselves—for instance, the placing of the cylinder or the cone so that it does not pass entirely through the sphere, changing the relative diameters, the angle at the vertex, etc.

Again, the student is advised not to follow in all cases the exact process explained for determining such intersections; there is usually more than one method which may be employed, and it is more advantageous as an exercise for him to devise a new one than to copy an old one. For instance, in Fig. 35, the curve of intersection was determined by making a series of sections of the cone and the sphere by horizontal planes, thus cutting circles from both surfaces. But if we suppose a vertical plane to be passed through the axis of the cylinder, seen edgewise, as $s'\ E$ in the top view, it will cut from the sphere a circle whose radius is $s'\ t$, or in the front view $s\ C$. This plane will also cut the cylinder in two right lines, which are the extreme visible outlines, or right and left hand elements in the latter view, where they are seen to cut the circle just spoken of in the points m and k, which consequently lie on the required curve. It will be



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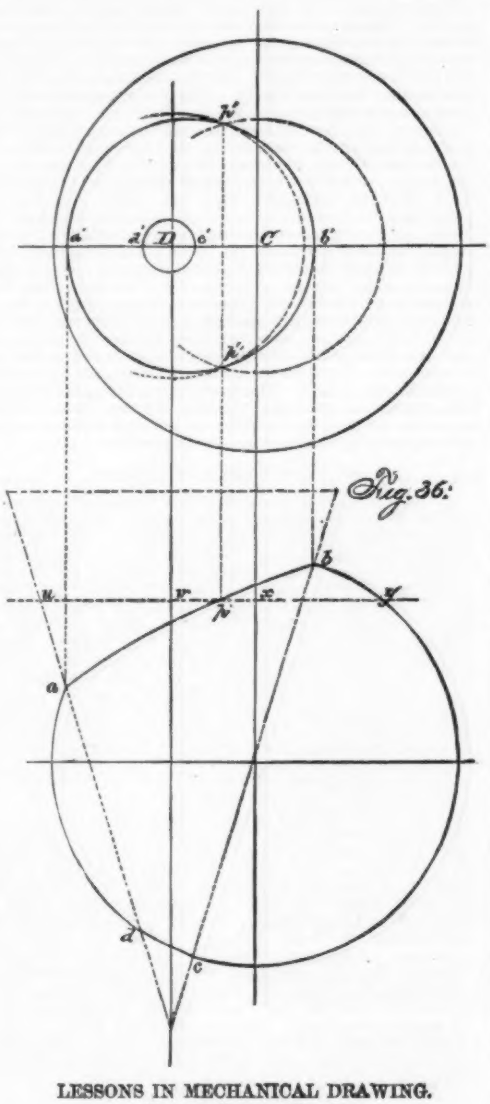
readily seen that a plane parallel to $s' E$ will cut two other right lines from the cylinder, and another circle from the sphere, whose intersections will give two new points on the curve, and the latter might therefore have been determined by a repetition of this process, instead of that first described. A somewhat similar method might have been used in the case of the cone and the sphere, Fig. 36; a plane through the vertex would cut two rectilinear elements from the cone, and a circle from the sphere and their intersec tions would also give points in the curve sought. We do not pretend that this would be as convenient a process as the one previously described, by which the curve was actually determined; but we mention it only as a hint to the reader, who will at the worst suffer no harm by attempting to construct the intersection in that way. But what we are aiming at is to induce him to think for himself; and one of the best things he can do, in order to acquire the power of doing so to some purpose, is to form in the first place a clear idea of the problem, drawing, if it be necessary to get such a clear idea, the two solids in the proposed positions. Then let him try to solve that problem himself, without reference to the solution given. It is not to be assumed that he will always succeed; at first he may find it necessary to read the explanation first; but then he should lay it aside, and endeavor to follow out the process without further reference to it. When he can do this, let him try to vary the method; and thus he will derive far more benefit from his study, and much sooner acquire the power to go alone, than if he contents himself with mere mechanical copying. This is the more strenuously urged, because in the nature of things it is simply impossible for us to present more than a few examples of cases of this kind, which are continually arising in practical work, with an endless variety of conditions, and with those the reader must cope when he meets them.



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SECOND SERIES, No. 5.

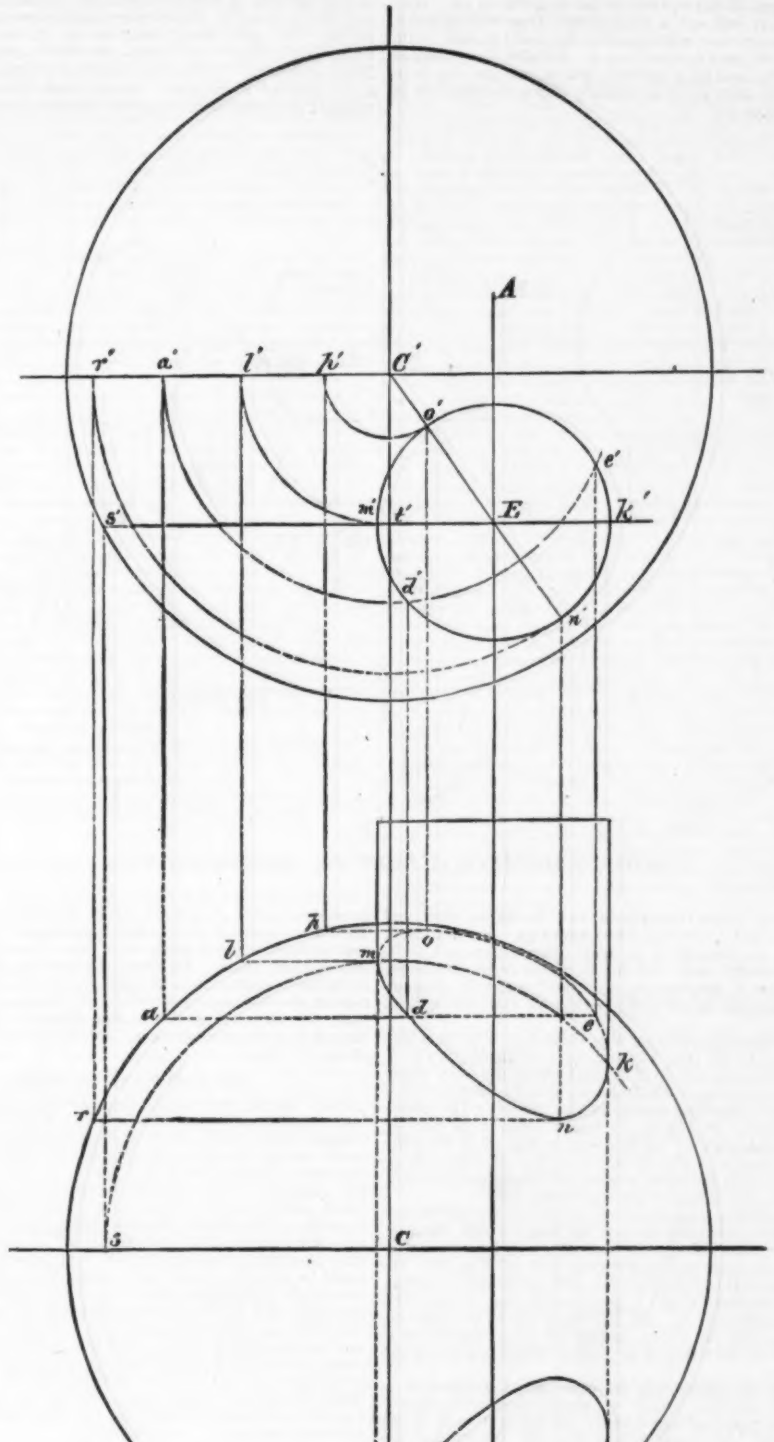
The two methods above mentioned both find an application in Fig. 37, which represents a torus, or ring of circular section, penetrating two cylinders. The axis of one of these cylinders lies in the plane of the equator of the ring, and passes through its center; the axis of the other is perpendicular to that plane, and intersects the central circle of the body of the ring.

The equator of the ring being horizontal and the axis vertical, the ring itself may be considered as a surface of revolution, generated by the circle $a\ b\ c$ in the side view. If now the ring be cut by a horizontal plane $x\ x$, the sections will be two circles whose radii are $C\ a'$, $C\ e'$, in the top view, e' and a' being the projections of e and a in the side view, in which points $x\ x$ is seen to cut the generating circle, or meridian line. These two circles cut, at p', p', the rectilinear element, which is cut by the plane $x\ x$ from the horizontal cylinder H; which element must in the top view be perpendicularly over p, the point in which $x\ x$ is seen in the side view to cut the base of this cylinder. Therefore p', p' are two points in the curve of intersection. In like manner any number of other points may be determined; evidently the horizontal plane through b will not cut the ring, but will be tangent to it all round the circle $b'\ r'\ q'$; and r', perpendicularly over r, will be the point in the curve nearest the center line in the top view.

As seen in the top view, these two circles through a' and e' pierce the vertical cylinder V in the points m', n'; which being projected up to the horizontal line $x\ x$, in the sectional view above, give m, n, two points in the curve of intersection as seen in that view. The equator, as we have called the largest circle of the ring, pierces the cylinder V at o' in the top view, whence o in the sectional view; and l is similarly derived from l', where the inner or least circle of the ring, which is in the same horizontal plane with the equator, pierces V, as seen in the top view.

When the ring is of great diameter, but small thickness, and the cylinders are also small, these curves will not differ very greatly from each other, and when viewed from the side will appear nearly circular. And we have known the impression to exist that they will be actually circular, so that if a hole were to be drilled through the cylinder the ring would fit it in any position—an idea apparently sustained by reference to the ring in the stem of a watch. We mention this as an illustration of the necessity of close observation, as well as of careful consideration, of what actually exists or does not exist in any given case. Doubtless, under certain conditions of proportion, the difference may be so small that for some purposes the fit and bearing thus obtained might answer. But it is not the less true that there is a difference, which is most conspicuous in the figure; in order more distinctly to show it, we have introduced views of each of these cylinders, showing the openings made in them as seen from the right hand side, which the student should find no difficulty in constructing. In regard to the drawing of the curves in those side views, it will be observed that they are made up of cylinder arcs, the centers of which are marked by small rings, and the terminations by arrow heads. We have before remarked that there is no objection to substituting such circular arcs for portions of any curve, when centers and radii can be found such that the arcs and the curve will agree so closely that the difference cannot be detected by the eye, the lines being as fine and sharp as they can be drawn. We repeat it, and call attention to the fact that this substitution is particularly advantageous when the curve, as in each of these cases, is symmetrical about a right line. The points must be determined in the first place, of course, and so close together as to define the curve with considerable precision; and the centers and radii for one half are then to be found by trial, after which they are copied on the opposite side of the line of symmetry.

Fig. 38 is a section of the ring shown in Fig. 37, by a vertical plane $L\ L$. This plane is seen edgewise in both the top view and the front view of Fig. 37. In the former it is seen to be tangent to the inner circle at l', in the latter to the



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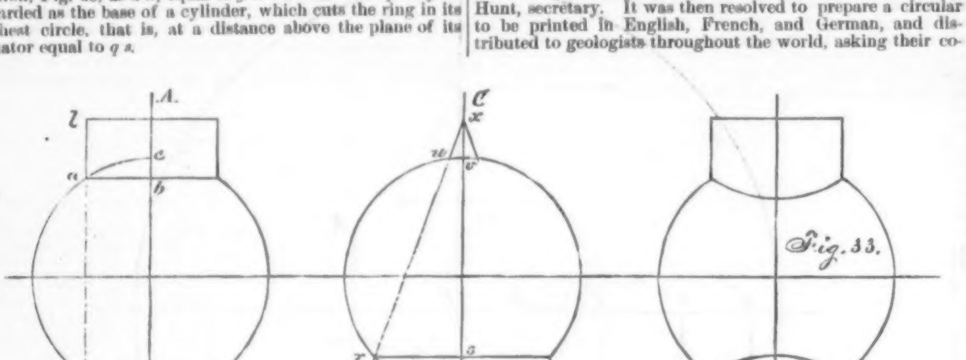
meridian circle at t; and as t and t' are but different views of the same point, this plane is evidently tangent to the ring at that point.

The vertex, w, of the section is at once found from w', the point in which the equator of the ring pierces the plane L L.

Other points may be found by an application of the principle above pointed out in connection with Fig. 34, viz., that the intersection of two surfaces of revolution having a common axis will be a circle. Thus the arc f d', whose center is C, may represent the base of a cylinder, having the same vertical axis as the rings, and it will also be the intersection of the ring and this cylinder, the distance of which above the plane of the equator of the ring will be g h. Now the plane L L will cut a vertical line from this cylinder, which in the top view will appear as the point d', and in the section, Fig. 38, as d h, equal to g h. So also b' r q' may be regarded as the base of a cylinder, which cuts the ring in its highest circle, that is, at a distance above the plane of its equator equal to q s.



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The plane L L cuts this cylinder at u' in the top view, and from this we find u v in Fig. 38, equal to q s. Proceeding in this manner we determine as many other points as may be deemed necessary, and find the curve to form two loops, like the figure 8, intersecting at t, and perfectly symmetrical with respect to both the horizontal and the vertical center lines.

A very different appearance is presented by Fig. 39, which is a section of the ring by a plane n n, parallel to L L. True, the curve is still symmetrical about the two center lines, but the loops have disappeared, and the intersection is a closed curve somewhat resembling an ellipse. The vertex y is found from y' of Fig. 37, as was w from w' in Fig. 38; and z h, the side view of the line seen in Fig. 37 as the point c, is equal to d h of Fig. 38 or g h of Fig. 37, being determined in precisely the same manner and from the same auxiliary cylinder, the radius of the base being $C f$.

Were the cutting plane to be moved still nearer to the axis than L L, still remaining vertical, the loops would separate, and when it passes through the axis they will become simply two circles, as seen in the sectional view of Fig. 37. The student is advised to construct the sections by such a plane, say midway between C and t, and also by one or more between L L and N N. In the latter cases we shall not have a loop, but the curve, instead of being convex as in Fig. 39, will be narrower in the center, forming a waved outline.

No doubt the reader will have perceived the identity of Fig. 38 with the case which has already presented itself to our notice as a part of the "finish" of the stub end of the connecting-rod, and illustrated in Fig. 28. If this has not suggested itself, it will, we think, be made apparent by the aid of Fig. 40, which represents the stub end as fitting at its neck within a ring precisely similar to that shown in Fig. 37. The ring itself is shown in section, and the curve of intersection, as seen on the stub end, is on one side continued, so as to form one side of one of the loops shown in Fig. 38.

The detail of constructing the curve, as explained in connection with Fig. 23, is slightly different from that above given; the student may satisfy himself of the fact that the curves are the same, and be none the worse for the practice, by extending that mode to the construction of the entire curve.

GEOLOGICAL AND OTHER NOTES.

A GEOLOGICAL CONGRESS.

Many geologists who have visited the Philadelphia Exhibition and seen the geological collection there have been impressed with the importance of having as nearly complete a collection as possible on exhibition, of geological specimens, maps, and sections, in accordance with a previously arranged plan. The International Exhibition to be held at Paris in 1878 will furnish such an occasion, and it is proposed to invite to that end governmental geological surveys, learned societies, and private individuals throughout the world, to send to Paris such collections as will make the geological department of that exhibition as complete as possible. In order to take advantage of the collections which may thus be brought together, it is moreover proposed to convoke an International Geological Congress, to be held at Paris at some time during the Exhibition of 1878, and to make that Congress an occasion for considering many disputed problems in geology. In accordance with this plan, it is proposed that the geological department of the International Exhibition of 1878 shall embrace: 1. Collections of crystalline rocks, both crystalline schists and massive or eruptive rocks, including the so-called contact formations and the results of the local alteration of uncrystalline sediments by eruptive masses. 2. Collections illustrating the fauna and the flora of the Palæozoic and more recent periods. 3. Collections of geological maps, and also of sections and models, especially such as serve to illustrate the laws of mountain structure. In pursuance of the above plan, the American Association for the Advancement of Science, during its annual meeting at Buffalo, appointed a committee to carry out this scheme, to which were added the names of Prof. Huxley, Dr. Otto Torell, and Dr. E. H. von Baumhauer. Prof. James Hall was elected chairman, and Dr. T. Sterry Hunt, secretary. It was then resolved to prepare a circular to be printed in English, French, and German, and distributed to geologists throughout the world, asking their co-operation in this great work of an International Geological Exhibition and an International Geological Congress, to be held at Paris in 1878; the precise date of the Congress to be subsequently fixed. All those interested in this project are invited to communicate with any one of the following members of the Committee—Prof. T. H. Huxley, London, England; Dr. Otto Torell, Stockholm, Sweden; Dr. E. H. von Baumhauer, Harlem, Holland; Dr. F. Sterry Hunt, Boston, Mass., U. S. A.

THE LAST POLAR EXPEDITION.

At a recent meeting of the Literary and Philosophical Society of Manchester, Prof. Osborne Reynolds, in justly animadverting on the large type sensation headings in which some newspapers announced what, in their perversity or ignorance, they called the "failure" of the Arctic expedition, showed that in truth the expedition had been one of the finest achievements ever accomplished. Looked at boldly, it comes to this: Since Hudson's time, more than 200 years ago, Arctic navigators had succeeded in penetrating about sixty or seventy miles of the 540 to be passed before the Pole could be reached. Whereas Captain Nares has, in one year, carried the British flag some sixty miles nearer, so that nearly one half—and this by far the most difficult half—of the entire results of all expeditions since Hudson's time has been accomplished by the last. And this is not all. Capt. Nares seems to have pursued the journey to its end, at least by that route; and in coming back can say that he did not leave a single uncertainty behind him. So far, therefore, from having been a failure, this has been the most successful expedition ever sent out.

PRE-GLACIAL MEN.

Prof. Hughes read a paper before the Cambridge Philosophical Society last Monday, in which he criticised the evidence offered to support the view that man existed on the earth during or before the glacial period. He first reviewed several of the older cases which had been put forward, and tried to show that the evidence was always incomplete, or that its trustworthy character disappeared on closer examination. Coming to the two more recent and important instances of human remains or implements being found beneath glacial beds, or in beds older than the glacial, Prof. Hughes gave his opinions from personal inspection and acquaintance with the localities. The human fibula found under glacial till in Victoria Cave, Settle, with *elephas antiques*, *Rhinoceros leptorhinus*, etc., had been regarded as decisive. Mr. Tiddeman (*Nature*, vol. xiv., p. 506) says, "The Settle till is undoubtedly of the age of the ice-sheet." Prof. Hughes said that, although the boulder clay at the mouth of the cave had got rather underneath the brow of the hill, yet from intimate knowledge of the physical nature and conditions of the district, which he had himself mapped, he saw no impossibility in the idea of the boulder clay having tumbled from the cliff above during the process of wearing back. Very often the upper limestone was so dissolved as to form pockets into which the boulder clay was let down, and then when an escarpment was disintegrated, he could quite conceive how such a pocket was thrown obliquely against the mouth of the cave in post-glacial times. This had ponded back the water that came into the cave, and necessarily produced a stratified deposit, in which the remains in question were found. With regard to the evidence brought forward by Mr. Skertchley, of the occurrence of palæolithic implements in brick earth beneath the chalky boulder clay at Thetford, near Brandon, he had visited the locality, and his opinion was that in each case there was a missing link in the proof that the clay beneath which the implements were found was identical with clay at no great distance which was indubitable boulder clay. In fact, there were many indications of the opposite. Local conditions in denudation, solution of chalk, formation of the valleys, etc., were abundantly present to mask the true state of things. The proof in this case was certainly not cogent; and it must be cogent to be accepted.

NORTHERN PACIFIC FORMATIONS.

In a communication to the St. Petersburg Society of Naturalists, Prof. Fr. Schmidt sketches the tertiary formations on the northern shores of the Pacific as follows: The formation consists of two stages. The lower is a continental miocene deposit with coal seams and numerous plants, the complete description of which will soon appear by Dr. Oswald Heer. This deposit has a very wide extent, having been found in the middle parts of the Amoor basin, on the Sakhalin, in Kamtchatka, Alaska, and on Vancouver Island; and nearly the same rich flora which it contains can be traced as far as the Mackenzie River, Greenland, and Spitzbergen. An immense continent between Northeastern Asia and Northwestern America must thus have existed at this epoch, and its flora shows the prevalence of a far warmer climate than now, probably like that which the middle parts of the United States now enjoy. The Upper Tertiary stage is a marine Pliocene deposit with numerous remains of molluscs, and it was observed on the Sakhalin Island (but wanting at the same time on the closely adjacent Siberian continent), in Kamtchatka, on the Aleutian Islands, in Oregon, U. S., and in California. Notwithstanding their varied lithological characteristics, these deposits contain a remarkably uniform fauna. The number of species already described by Prof. Schmidt, on the basis of large collections made during the last thirty years, is eighty, out of which eighteen have no living representatives, six inhabit only the Polar Sea and the Northern Atlantic, and the remaining fifty-six still inhabit the Northern Pacific. Out of the eighteen extinct forms six were already found in the Tertiary of Oregon and California, and one of them (*Nucula cymani*, Girard) will probably prove to be the same as the *N. cobboldiæ*, Sow., of the English Crag. Generally, during the Pliocene epoch, the faunas of the northern parts of the Pacific and the Atlantic were far more alike than now, and it must be supposed that the connection between both oceans through the Polar Sea was far closer than now—a supposition supported also by the close likeness of some forms inhabiting the Pacific and the Atlantic shores of Northern America. Their close likeness, which appears so strange when we learn that they do not now inhabit the Polar Sea, is perfectly explained when we find them in a fossil state in the Pliocene deposits of the far north, as was the case with the *Pholas crispata* and the *Pectunculus pilosus*, which were found fossil, the former on the Northern Dwina and Jenissei, and the second on the Kadiak Island. The fossil fauna of the Arctic regions thus explains the present distribution of forms. Prof. Schmidt expresses the wish that the Pliocene deposits of these regions were thoroughly explored as soon as possible.

POST GLACIAL PERIOD IN ESTHONIA.

At the meeting in October of the Geological Section of the St. Petersburg Society of Naturalists, Prof. Friedrich Schmidt made an interesting communication of the Post-Glacial Period in Esthonia. Starting from the supposition—which he supports in common with Swedish and Finnish geologists—that Esthonia was covered during the Glacial period with an ice sheet which concealed it with Scandinavia, Finland, Northern Russia, reaching probably the southern slope of the Waldai plateau, Prof. Schmidt proved that after the melting of the ice the country was covered with numerous immense lakes. The land was then submerged by the sea, but only to a small extent, as notwithstanding many years' careful researches, formations with marine fossils have not been found in Esthonia further than 30 kilometres distant from the Gulf of Finland, nor on levels higher than sixty feet above the sea. They are Post-Glacial, containing a fauna which, with very few exceptions, inhabits now the Baltic. After the submergence the land rose to its present height, but this elevation was probably accomplished during pre-historic times. At least, M. Schmidt states, contrary to the assertions of MM. Baer, Helmersn, and others, as to the present rising of all the islands in the Gulf of Finland, there was not in Esthonia, evidences of the rising of the land during the last four centuries which could be accepted as unmistakable. It may be remarked that the conclusions of Prof. Schmidt as to the small submergence of Esthonia, however contradictory of current opinions, are also supported by the circumstance that marine formations were not found in Eastern Sweden above a level of 100–120 feet; and that in Finland the traces of marine clays (with *Cardium edule* and *Tellina balthica*) totally disappear at a level higher than 62 feet. These negative evidences have some weight, both countries having been well explored along some parts of their coasts.

PROTECTION FROM LIGHTNING.

At a recent meeting of the Literary and Philosophical Society of Manchester, on October 17, Mr. Baxendell drew attention to the paper "On the Protection of Buildings from Lightning," read by Prof. J. Clerk Maxwell at the late meeting of the British Association at Glasgow, and stated that the system of protection recommended by the professor, and which he appears to have regarded as new, was suggested, and its adoption strongly advocated, nearly forty years ago, by the late Mr. Sturgeon, whose many valuable contributions to electrical and magnetical science seem to have been strangely overlooked by recent investigators and writers. The paper in which the system was first described was read before the London Electrical Society on March 7, 1838, and an abstract of it was published in the second volume of the "Annals of Electricity." There is, however, one important difference between the two systems. Mr. Sturgeon considered it necessary that the copper sheathing or covering of a protected room or powder magazine should be well connected with the ground; but Prof. Maxwell is reported to have stated that "there would be no need of any earth connection. They might even place a layer of asphalt between the copper floor and the ground, so as to insulate the building." It is obvious, however, Mr. Baxendell states, that if the magazine were struck by lightning, a disruptive discharge through the layer of asphalt would in all probability take place, which might rupture the copper sheathing, and thus ignite the contents of the magazine; but by the adoption of Mr. Sturgeon's plan an accident of this kind could not occur.

TYPHOID FEVER.—TREATMENT.

FROM A LECTURE ON FEVERS.

By ALFRED L. LOOMIS, M.D.,

Professor of Pathology and Practical Medicine in the Medical Department of the University of the City of New York.

WHEN quinine is employed as an antipyretic, it must be given in large doses; the administration of two grains every two hours, or a larger quantity administered in divided doses within a period of twenty-four hours, will not act as an antipyretic; but thirty or forty grains must be administered within a period of two hours.

If the stomach is irritable, and you fear that a large dose will produce vomiting, ten grains may be given every half hour until the desired quantity has been administered.

Usually from four to six hours after the antipyretic dose has been taken, the fall in temperature will begin, and in about twelve hours it will reach its minimum height; then it will remain stationary from twelve to twenty-four hours. After the temperature has once been reduced by the quinine, its administration may be discontinued until the temperature shall again rise to 105° F. As a rule, the temperature rarely ranges as high as before the quinine was administered.

This mode of administering quinine in antipyretic doses to fever patients rarely produces any symptoms of cinchonism, other than a transient deafness after the first dose. In a large number of cases the temperature can be kept below 103° F. by the sulphate of quinine; but in very severe cases it will be advisable, and sometimes it will be absolutely necessary, to employ not only the quinine but at the same time the cold baths. My rule is, after I have reduced the temperature to 101° F., or 102° F., by a cold bath, to administer an antipyretic dose of quinine, and thus delay the recurring rise of temperature. While the cold bath more rapidly reduces temperature, the effect of the quinine is more lasting; consequently, by making use of both of these reliable antipyretics during the first two weeks, you will be able to control the temperature during that time. After this period it is not safe to resort to cold baths; but when the temperature rises above 103° F., occasionally you may use the cold pack in connection with antipyretic doses of quinine. If, during the third and fourth weeks, you fail to reduce the temperature by these means, administer during the twenty-four hours from ten to twenty grains of powdered digitalis—unless the pulse is very frequent and irregular—when its use is contra-indicated. As an antipyretic, digitalis should be administered only when quinine is given. It seems to increase the antipyretic power of the quinine, but has little or no power when administered alone.

The use of all these antipyretic remedies must be persisted in until the desired end—the reduction of temperature—is accomplished; but the peculiarities of each patient must be studied, and these agents must be so administered as to suit each individual case.

You cannot trust to the judgment of nurses and attendants, but you must determine for yourself what are the requirements in each case.

The satisfactory results obtained by the systematic use of these remedies justifies their employment; but the exact rules which are to govern one in their use, as to manner and time, can only be determined by experience.

All careful observers are aware that great danger attends prolonged high temperature; but it is still an unsettled question whether this danger is due to parenchymatous changes in the different organs, which some claim are the result of the high temperature, or to disturbance of the nerve centers, from the same cause. Whatever may be the final settlement of the question, the beneficial results which follow the antipyretic treatment of fevers are generally admitted; and my advice to each one of you is, at the onset of your professional career, to make yourself perfectly familiar with the use of these most important and reliable antipyretics.

If you can keep the temperature of your patient at about 103° F. during the first two weeks of the fever, you have accomplished the *first* and perhaps the most important thing in the treatment of this disease.

Towards the end of the second, or during the third week—sometimes earlier, sometimes later—signs of failure of heart power begin to manifest themselves; the pulse becomes feeble and irregular; at times the surface is cool and moist; the patient complains of a sense of exhaustion, perhaps is unable to turn in bed; the tongue assumes a dry, brown appearance, and the necessity of supporting the patient becomes apparent. This will bring you to the *second* important question in the treatment of this fever—namely, *what means shall be employed to sustain heart power*, or, as it is sometimes said, the vital powers of the patient?

When a patient, during the second or third week of the disease, dies from capillary bronchitis, pulmonary œdema, or suddenly passes into a state of coma, failure of heart power is the real cause of death.

In those cases in which, during the early part of the fever, you have been compelled to resort to a vigorous antipyretic treatment, during the third week, although the temperature may not rise higher than 101° F., the pulse frequently becomes extremely feeble, and reaches 140 per minute, the first sound of the heart becomes inaudible, muscular tremors, dry tongue, and all the phenomena which indicate failure of vital power are present. Under such circumstances the use of stimulants seems to be urgently demanded.

There are a few simple rules which may guide you in the administration of stimulants in this fever.

First.—They should never be administered indiscriminately—that is, never give a patient stimulants simply because he has typhoid fever.

Second.—When there is reasonable doubt as to the propriety of giving or withholding stimulants, it is safer to withhold them, at least until the signs which indicate their use become more marked.

Third.—In every case, but especially when stimulants are not clearly indicated, watch carefully the effect of the first few doses. There are few whose experience in the treatment of typhoid fever is such as to enable them to positively determine, from the appearance of the patient, when the administration of stimulants should be commenced.

Should you commence the administration of stimulants, it is necessary to see your patient every two hours, and note carefully the effect produced. If you find the tongue becoming dry, the patient more restless, the delirium more active, the temperature ranging higher, and the pulse more and more rapid, you may be certain that stimulants are contra-indicated. If, on the other hand, the pulse becomes fuller and more regular, if the first sound of the heart is more distinctly heard, or, if it has been absent, it has returned, if the restlessness and delirium is less marked, the tongue more moist, and the patient more intelligent, you may be certain that the time for the administration of stimulants has arrived. When you have commenced their use, it is of the greatest importance that you administer them at stated intervals, especially during the night.

In a severe case of typhoid fever, a free administration of stimulants, just at a critical period (which may not last more than twenty-four hours), will often be followed by a refreshing sleep, and your patient may rapidly pass from an apparently hopeless condition to one of convalescence.

The *third* important thing to be accomplished in the management of typhoid fever patients is the maintenance of nutrition. You must bear in mind that the primary and principal effects of the typhoid poison are manifested in the changes which take place in the lymphatics of the gastro-intestinal tract. Experience has taught us that the enfeeblement of the digestive and assimilative powers, due to these glandular changes, which are manifest from the very commencement of the fever, renders the digestion of solid food impossible, and for a long time it has been the rule of the profession to allow typhoid fever patients only liquid food.

There has been and still is great diversity of opinion in regard to the special articles of diet best suited to this class of patients. Most medical writers and practitioners claim that beef tea is the proper diet for fever patients; consequently it is the rule to pour into these enfeebled stomachs a decoction of beef in such quantities as a healthy stomach could hardly tolerate, and which, in itself, has little or no nutritive element.

Others claim that gruels are far superior to animal broths, and advocate the feeding of fever patients with gruel made of barley and other farinaceous substances, to the exclusion of every other article of diet; yet gruels furnish few elements essential to the nourishment of a physical organization struggling against a subtle poison, and rapidly wasting with a burning fever, and starvation is the necessary result of a restriction to gruel diet.

There is no disease in which the waste of all the tissues of the body goes on so rapidly as in typhoid fever; and milk is an article of diet which furnishes the elements of nutrition necessary to repair this rapid waste, and there are not the objections to its use which there are against animal broths and gruels. Although there have been, and still are, in some quarters, strong objections against its use as an article of diet in fevers, recently it has been regarded with more favor, and those who have had most extended opportunities for testing its nutritive qualities have come to regard it as the only article of diet required by fever patients. In it we not only find all the elements required for repairing the rapidly wasting tissues, but they are in a condition to be most readily assimilated by the enfeebled digestive apparatus.

In order to make the milk more digestible, it may be diluted with lime water. The lime water is an antiseptic, and allays irritability of the stomach and intestines. The quantity of milk is not limited; the patient may take all his stomach will digest—usually patients will take from four to six quarts in the twenty-four hours.

After the patient has passed into the fourth week of the disease, you may find it necessary to administer cream and the yolk of eggs in connection with the milk.

The lecturer then proceeded to consider the treatment of the various accidents of the disease.—*Medical Record.*

HYDROPHOBIA CURED BY OXYGEN.

WE have the authority of Schmidt and Lebedew for the following case:

A girl, aged twelve, was bitten by a rabid pup, in the hand, on January 7th, 1876. The wound extended into the subcutaneous cellular tissue; there was scarcely any bleeding; it was at once cauterized with lapis, and had entirely healed on the seventh day. The child had suffered an attack of diphtheria three months before, which had left paralytic aphonia behind it. About the time when the wound closed she was observed to be uncommonly excitable. On the seventeenth day severe dyspnœa suddenly set in; inspiration free; expiration difficult, interrupted in character; deglutition almost impossible; pulse rapid; fingers contracted. In the course of twenty-four hours neither urine nor fæces were voided. The inhalation of about three cubic feet of oxygen produced immediate amelioration of the symptoms, and within two and a half hours apparently restored her to her former condition of health. The next day she had a more severe attack, with tonic spasm of the muscles of the back and limbs; respiration spasmodic; complete loss of consciousness. These symptoms were relieved in forty-five minutes by the inhalation of oxygen. Slight remaining dyspnœa was treated in the same manner for the following ten days, with the addition of *camphora monobromata*, which was given for three weeks. In the first part of February she had paralysis of both lower extremities for two weeks; since then she has been entirely well, excepting the aphonia, which existed before she was bitten.—*Allgemeine Medicinische Central Zeitung.*

LYMPH.

THE efficacy of pock lymph has been attributed by several observers to the presence of small organisms of the nature of Micococcus. M. Hiller has recently studied this subject (*Centralblatt für d. Med. Wiss.*,) and from 6,840 separate inoculations, he finds that the degree of activity of the lymph and the proportion of micrococci present do not correspond; on the one hand, the development of the organisms was often at its greatest when the action of the lymph was falling off, and on the other, lymph was often active, though no bacteria were perceptible in it. Fresh diluted lymph having been put in vertical tubes in a freezing mixture, and slowly thawed after freezing, the upper half gave, on inoculation, 41·4 per cent positive results, the lower half 63·8 per cent. It appears from this that the poison is associated with the solid constituents more than with the liquid. Boiled lymph was, without exception, inoperative. The addition of 1 to 4½ per cent carbolic acid merely weakened the contagiousness of pock lymph, while addition of glycerine left it unaltered. Strong dilutions weakened the action, while condensations exalted it; with evaporation, the percentage of favorable cases was increased about a half. In coagulated parts produced in the lymph, the active element was present in great quantity. Perfectly dried lymph is also active in high degree; hence we may infer that the communication of pox may occur by means of the crust and scurf of pustules which are rubbed off and float in the air. Inoculation with the blood of persons that were successfully inoculated proved inoperative; so also were the fresh contents of the bladders, seven days after inoculation. It is inferred that the cow-pox ferment is not contained in the blood, or not in the active state; and that very probably, also, the blood is not itself the seat of fermentation and reproduction of the poison.—*Nature.*

CHLORAL HYDRATE IN SCALDS AND BURNS.

By S. S. RIDDELL, M.D., Chippewa Falls, Wis.

EARLY in the morning of November 14th, 1876, as I was starting on my regular round of visits, a man rode up on horseback in great haste, and summoned me to visit his brother at once, who, he stated, had been badly scalded in the face and eyes.

I had long since determined to try the effects of hydrate of chloral in such cases, and therefore provided myself with the following mixture, in addition to the ordinary opiates, etc., viz.:—

℞. Hydrate of chloral, ℥ iij.
Carron oil, ℥ vj. M.
Sig.—Use as directed.

and proceeded to a farm house, distant six miles, where my patient (James Hedrington, aged eighteen) lived. On inquiry I learned that he was sitting near the stove, his elbow resting on his knee, and his hands supporting his chin, when the contents of a tea kettle and a teapot, both full and boiling, were accidentally precipitated in his face. Molasses had been smeared over the face previous to my arrival. On entering the room, the young man was pacing the floor, his gait a little unsteady, the pain being so great as to call forth moans and cries. On removing the molasses from his face, and making an examination, I found that the face and one eye were badly burned, the skin hanging in shreds from his forehead to his chin; one hand very slightly injured; pulse 96; respiration rapid (not counted); mind slightly confused. I at once applied the hydrate of chloral and carron oil mixture freely, by means of cotton wool, forming a complete mask, leaving no opening except for respiration and for the mouth. At first there was a sharp, stinging sensation, lasting not over from one half to one minute, followed by a rapid diminution of pain. *Within ten minutes after my arrival at the house, the patient* (with the exception of a slight burning sensation in the left eye) *was free from pain, and within twenty minutes was asleep.* I exhibited, in connection with the local treatment, about twelve grains of bromide of potassium every four hours, for a few days. Opiates were entirely unnecessary. The result of the use of hydrate of chloral was almost an entire absence of pain after the first application, and a continued drowsiness at first, which diminished as the case improved. During the first four days there was considerable swelling of the face, the eyelids being œdematous and closed, and profuse lachrymation, after which the swelling rapidly diminished, the appetite (which was absent at first) commenced to return, and the case rapidly convalesced, the left eye remaining somewhat injected, which finally passed away without unpleasant consequences. The patient, ten days since, was *well*, with no perceptible scars. The success of the use of hydrate of chloral in this case was so marked that I shall feel encouraged to extend its use in similar cases. It may be that the shock, on first applying the mixture, would be too great in cases where very large portions of the surface of the body were affected. The chloral could be added to Dr. Buck's, Mr. Rice's, or a number of other "burn mixtures," as might be thought best. If I have ever read anything with regard to the similar use of hydrate of chloral in cases such as I here report, it has slipped my memory, and if other physicians will give it a fair trial and report results, I shall be more than repaid for making this report.—*Medical and Surgical Reporter.*

THERAPEUTIC USES OF THE CYANIDE OF ZINC.

THIS substance has been used as an anthelmintic, and in nervous diseases, by the Germans, and is officinal in the French Codex. Recently, Dr. Deschamps, of Liege, has used it as an antipyretic in acute rheumatism. He gave about one twelfth of a grain, two to five times a day, in nine cases. M. Deschamps gives an account of these nine cases in the *Paris Medical*, and adds the following remarks:

We must agree, if we abide by the preceding observations, that cyanide of zinc in small doses is a very valuable agent in acute articular rheumatism; under its influence, the pulse rapidly fell, sometimes to an inexplicable degree; the pains were rapidly diminished, but the temperature did not immediately come under this favorable influence. We also remarked that on the second or third day there was always an increase in the temperature, although the pulse maintained its ordinary rate or even fell below it.

These different effects of the cyanides, retardation of the pulse, lessening of the pain, and downfall of the temperature, have long been remarked; we can only conclude, then, that these observations have confirmed them by applying to acute articular rheumatism the physiological and therapeutic effects of cyanide of zinc.

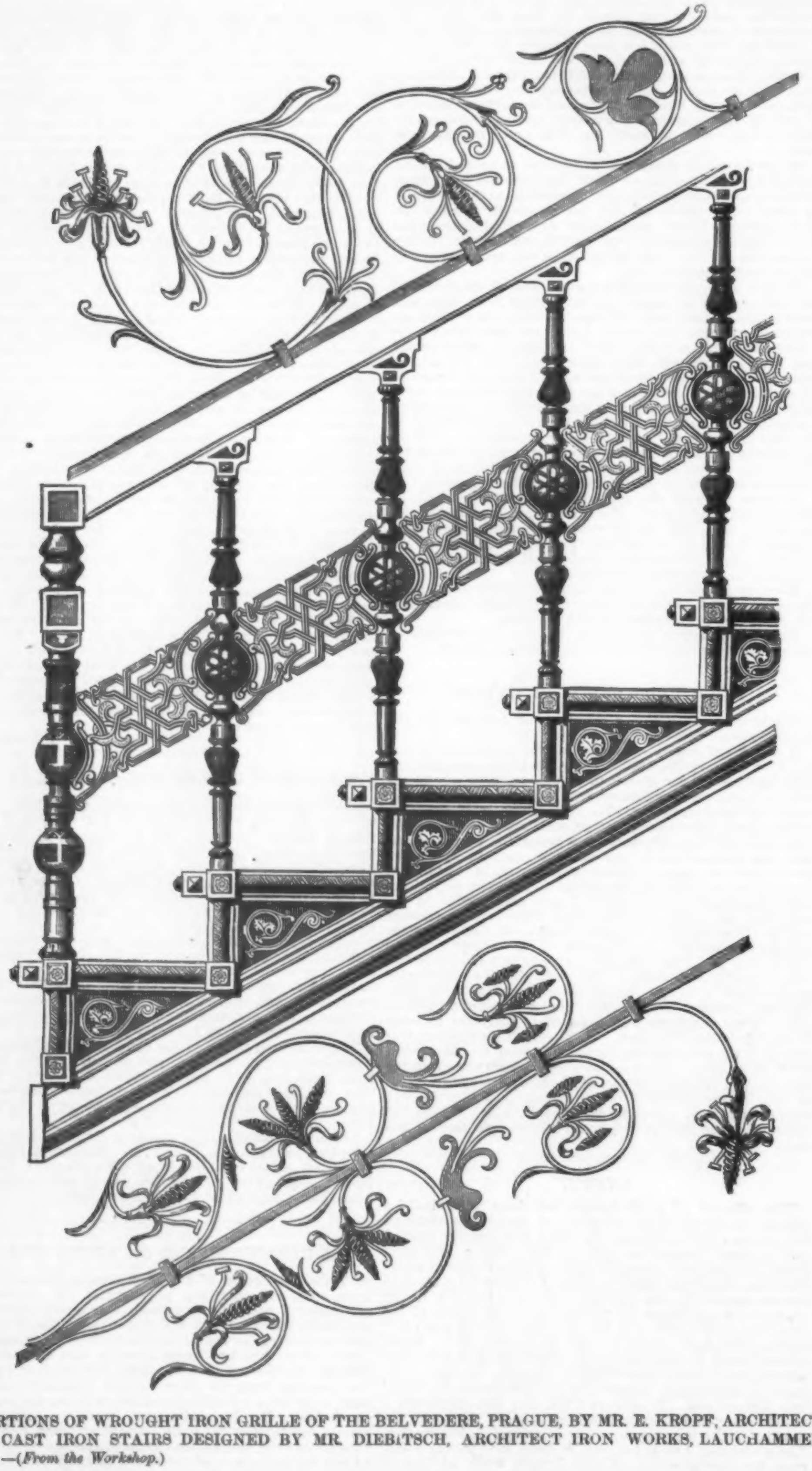
Let us add that other reasons are in favor of this cyanide salt; its administration is easy, its elimination rapid, perhaps even cardiac complications are less frequent; we have, indeed, only had one well marked case of endocarditis in the nine observations which have been recorded.

DR. BROWN-SEQUARD ON NERVE DISEASE.

THE recent lectures of Dr. Brown-Sequard show him quite apart from the prevailing physiologies. He teaches that symptoms of paralysis, anæsthesia, amaurosis, aphasia, etc., are due to irritation, and not cessation in the function of various parts of the brain; for irritation of parts around the portion destroyed by disease causes certain sensations; not that the part destroyed causes them, but because an irritation starting from the place around influences cells, some near, some at a considerable distance from, the locality of the lesion. Dr. Brown-Sequard, therefore, believes that certain functions of the brain, instead of being localized in clusters of cells, are, on the contrary, spread over the greater (if not the entire) part of the brain; and this theory explains a very large number of cases of disease which otherwise it would be impossible to understand. Parts in the brain supposed to be endowed with special functions can be destroyed without any alteration in the loss of functions, and *vice versa*; so that it follows that any part of the brain can produce anæsthesia, aphasia, paralysis, or amaurosis, and parts supposed to contain special functions can be destroyed without causing aphasia, amaurosis, etc. As regarded treatment in cerebral affections, Dr. Brown-Sequard places most reliance on the actual cautery brought to a white heat, and scored along the back of the neck, opposite the last cervical and first dorsal vertebræ. Strychnia also, pushed so as to produce spasmodic movements, is of considerable service, but perfectly useless in smaller doses.—*Med. and Surg. Reporter.*

PICTORIAL CRYSTALS.

The three instruments which, whether used separately or in combination, are capable of yielding probably the greatest amount of intellectual enjoyment—with which no educated man should be unacquainted, and which no one who can afford them should be without—are the camera, the lantern, and the microscope. There is no season of the year and no hour of the day in which one or other, or, indeed, all together, may not be made to minister to the intellectual pleasure and educational pursuits of those who possess and know how to use them, and in the use of no other instruments is it possible to more deeply interest, educate, and amuse a circle of friends, whether at the fireside or in a public assembly.



PORTIONS OF WROUGHT IRON GRILLE OF THE BELVEDERE, PRAGUE, BY MR. E. KROPF, ARCHITECT. CAST IRON STAIRS DESIGNED BY MR. DIEBITSCH, ARCHITECT IRON WORKS, LAUCHAMMER. —(*From the Workshop.*)

Thanks to the camera, the lantern has long ceased to be a mere toy fit only to amuse children, although even in that humble sphere it did good work in its early days; but, in consequence of the thousands of pictures from nearly every part of the known, and many parts of the almost unknown, world that can be bought for a mere nominal sum, the general public may readily become nearly as well acquainted with the ruined temples of Egypt, India, or Central America, as with Cheapside or Charing-cross. Aided by the microscope the lantern is gradually finding its way into the lecture room as one of the very best exponents of physiology and natural history, and the time is not far distant—if it has not already arrived—when it will be considered absolutely essential for the proper illustration of most branches of natural science.

Great as are the benefits which have resulted from a union of the camera and the lantern, we believe that, from an educational point of view at least, they will be much greater from the union of the lantern and the microscope; and, with a view to stimulate those who have opportunity for that kind of work, we are anxious to direct attention to a phase of it which, although capable of producing most beautiful effects, has been too much neglected; we allude to the production of lantern pictures, if we may so call them, from microscopic crystals both by plain and polarized light.

We are aware that, so far back as 1853, Dr. Strethel Wright, of Edinburgh, who has only recently been removed by death, made some beautiful copies of such crystals on daguerreotype plates, and that in 1864 he publicly exhibited a series which had been taken on wet collodion, and colored to show the effects of polarized light. In 1874, M. Jules Girard gave to the French Academy of Sciences an account of some experiments he had made in the same direction; but, so far as we are aware, these experiments have not resulted in any practical application. This is the more surprising as the operation is simple enough, and crystallography is a subject of much interest, while its exhibition with polarized light is probably one of the most beautiful things in nature. We have, unfortunately, not yet attained to the knowledge of how to prepare a film that will give the colors of crystals as seen by polarized light, and possibly never may; but we know from experience that it is less difficult to lay on such washes of transparent color as shall prove wonderfully accurate representations of them than it is to paint a good lantern picture.

With a view to the approaching "lantern season" we were looking out our apparatus some weeks since, and, remembering that a series of simple pictures are apt to be monotonous, were anxious to secure something that could be easily introduced by way of variety. Crystallography occurred to us, and we at once set about the necessary experiments, and with such success that we think the following account of them may be proved useful.

The first requisite is, of course, the production of suitable crystals, and this is an operation requiring considerable care. The ordinary way for microscopic examination, as is well known, is to lay a drop of a solution of the salt to be crystallized on a slip of glass, warm it over a lamp, and then allow it to cool; or to watch the process of crystallization as it cools. In consequence of the want of depth of focus of the microscopic lens only one plane can be brought into focus, and therefore the crystals must be both as transparent and as thin as possible. We have succeeded well by using somewhat weak solutions, and placing the slips of glass under a bell jar along with a capsule containing sulphuric acid. Several slips of each salt should be laid down, as they vary much in suitableness, and the best can then be selected. The operation should in no case be hurried, as some of our best specimens took fully twenty-four hours to crystallize. As a rule the crystals should be photographed as soon as possible after they are made, as most of them change very rapidly—some by deliquescing, and some by efflorescing—while the evaporation of the "mother liquor" leaves others in an opaque, powdery state. We need not particularize the salts that are most suitable—each experimentalist will find pleasant amusement and useful information in ascertaining that for himself; but we may say that chloride of sodium, ferrocyanide of potassium, nitrate of sodium, nitrate of potassium, sulphate of iron, and sulphate of copper will afford examples of all the six systems included in crystallography, while sulphate of quinine, salicine, and hydroclorate of morphia give objects of extreme beauty.

The microscope is arranged as for ordinary microphotography—that is, placed horizontally, and the eyepiece and tube removed and inserted light-tight into the lens mount in an ordinary quarter plate camera, the lenses, of course, being removed. In some microscopes it is not possible to remove the tube, as the object glasses are screwed into its lower end. In such a case the eyepiece may either be removed and special precautions taken to prevent reflection from the sides of the tube, or it may with advantage be left in its place. Here we may state that, in photographing crystals for the magic lantern, a microscope and microscopic objectives are not really necessary; for, as we have shown in a previous article, and as the late Mr. John Bockett demonstrated at a meeting of the now defunct North London Photographic Association, a photographic lens of short focus answers this purpose most admirably, possessing also the advantage of having its visual and chemical foci coincident, which is not the case with microscopic objectives. Various methods of illumination were tried, including the use of the ordinary mirror with sunlight and the oxhydrogen light; for low powers, however, an argand paraffin lamp answers quite well, when used with the condenser. For simple lantern pictures extremely beautiful effects are produced by polarizing the light, the analyzer being turned so as to show the crystals on a dark ground. This necessitates a much longer exposure, but with a dry plate that is of little consequence. The only difficulty likely to be experienced is in focussing, as the fine adjustment requires to be turned to correct the difference between the chemical and visual focus; but with a few trials the amount of turning may be marked, and then the adjustment can be made accurately. The plates we find most certain and successful are the ordinary emulsion with slight excess of bromide—a sufficient excess, in point of fact, to give with a strong alkaline developer a bright, clear, dense image. Of course the exposure is in all cases long, and varies much with certain salts; in some instances we have given with an argand lamp as long as fifteen minutes before a suitable impression could be made.

Very fine effects, also, but of a different kind, may be obtained by condensing the rays from the lamp on the crystals, and thus using reflected, instead of transmitted, light. In this case the back of the glass slip should be covered with a piece of moist, red blotting paper, which prevents a certain blurring of the image that we attributed to reflection through the glass. The backs of the sensitive plates must also in all cases be covered with an opaque backing.

We have, of course, merely given a slight outline of how a very beautiful and useful series of lantern pictures may be produced by any one having a microscope at his disposal; and, while such experiments would afford pleasant amusement during the winter evenings to the amateur, doubtless the professional maker of slides would find the crystallographic pictures a profitable addition to his stock.—*British Journal of Photography.*

PHOTOGRAPHY OF MUSICAL TONES.

The "photography of tones" has been accomplished by Dr. Stein in a way which he describes in *Poggendorff's Annalen*. One variety of his method consists in fixing a tuning fork horizontally with its branches in vertical planes; there is a hole bored through the upper branch, and a horizontal beam of light of somewhat larger section than the hole is directed on this from a heliostat. Part of the beam passes through to a sensitized plate in a case, which plate is made to move rapidly in a horizontal direction by means of a spring, or the like. Thus the luminous circle (on the plate) which, when the fork is vibrated and the plate at rest, gives a vertical line, gives a horizontal sinuous line when the plate is put in motion. The rate of motion of the plate being fixed, there will be a different number of undulations in a given space for each fork of different pitch. The curve has some interesting features; thus, it is much brighter at the bends than at the intermediate parts, the motion having been slower at the points of turning. The gradual retardation and acceleration are clearly shown. Dr. Stein finds it possible to photograph all ordinary musical tones, and even those vibrations which are above the upper limit of audition. He applies his method to strings also; fixing on these, with light supports, small square disks of blackened mica with a hole for admission of the light. Several cords in a row may have their periods photographed together on the same plate, the mica disks rising one above another.

Prof. Mach, of the Vienna Academy, has recently made some experiments on the velocity of propagation of sound-waves from explosion. He finds that in course of the motion this velocity diminishes, and soon approximates to the ordinary velocity of sound.